CHAPTER 7

PHARMACOLOGY AND TOXICOLOGY

INTRODUCTION

As you advance in rate, you will become more and more involved with the intricacies of administering medicines. Although the drugs and their dosages are prescribed by the medical officer and other authorized prescribers, you, as the hospital corpsman, are involved in their administration. It is necessary for you to learn their sources, composition, methods of preparation and administration, and physiologic and toxicologic action. This chapter is concerned primarily with the action, use, and dosage of drugs.

The subject of pharmacology was known as Materia Medica until 1890 when the current term began to come into use. The subsciences of pharmacology and their specific fields of study are as follows:

PHARMACOGNOSCY.—The recognition, quality, purity, and identification of drugs.

PHARMACY.—The preparation, stability, preservation, and storage of pharmaceutical preparations.

POSOLOGY.—Dosage or amount of drug to be given.

PHARMACODYNAMICS.—The response of living tissue to chemical stimulation in the absence of disease. This almost exclusively deals with research and development.

PHARMACOTHERAPEUTICS.—The action of drugs on living tissue in the presence of disease; treatment of the sick.

TOXICOLOGY.—The toxic or poisonous effects of substances.

The art of treating disease by any method that will relieve pain, cure disease, or prolong life is called therapeutics. Although the average person thinks solely of giving or taking medicine in this respect, it must be remembered that therapy also includes other methods, such as radiological treatment, diathermy, hydrotherapy, and many more.

DRUG STANDARDS

The texts dealing with pharmaceutical preparations include the *United States Pharmacopoeia and National Formulary (USP-NF)* which provides standards for drugs of therapeutic usefulness and pharmaceutical necessity. Inclusion of drugs into this compendia is based on therapeutic effectiveness and popularity. It provides tests for identity, quality, strength, and purity.

The *Physicians' Desk Reference is* a multiple index of commercially available drugs and is used as an advertising outlet for various drug manufacturers. Pharmaceutical preparations are described as to composition, action and use, administration and dosage, precautions and side effects, dosage forms available, and the common (generic) name of the drug.

Remington's Pharmaceutical Sciences is probably the most widely used text/reference in American pharmacy. It contains all areas relevant to the art/science of pharmacy. The *Pharmaceutical Basis of Therapeutics* (Goodman and Gilman) is a textbook of pharmacology, toxicology, and therapeutics known as the "blue bible" of pharmacology.

MEDICATION ADMINISTRATION

The quantity of a drug to be administered at one time or the total quantity administered and the method of administration of drugs is dependant upon several factors. This section will cover some of the methods of administration and some of the factors affecting dosage calculations.

DOSAGE

The amount of medication to be administered is referred to as the dose. The study of dosage and the criteria which influence it is called posology. The doses given in the *United States Pharmacopoeia and National Formulary (USP-NF)* are average therapeutic doses and are known as

"usual adult doses." The following terms are used in connection with doses:

Therapeutic dose.—Also referred to as the normal adult dose, the usual dose or average dose, it is the amount needed to produce the desired therapeutic effect. This is calculated on an average adult about 24 years old, weighing approximately 150 pounds.

Dosage range.—A term that applies to the range between the MINIMUM amount of drug and the MAXIMUM amount of drug required to produce the desired effect. Many drugs, such as antibiotics, require large initial doses that are later tapered to smaller amounts. Closely associated with this term are MINIMUM dose, the least amount of drug required to produce a therapeutic effect; MAXIMUM dose, the largest amount of drug that can be given without reaching the toxic effect; and the TOXIC dose, the least amount of drug that will produce symptoms of poisoning.

Minimum lethal dose.—The least amount of drug than can produce death.

FACTORS AFFECTING DOSAGE

In the administration of medicines there are many factors that affect the dose, method of administration, and frequency of the dose. Although a physician prescribes the amount to be given, you need to know how and why these quantities are determined. The two primary factors that determine or influence the dose are age and weight.

Age

Age is the most common factor that influences the amount of drug to be given. An infant would require much less than an adult. Elderly patients may require more or less than the average dose, depending upon the action of the drug and the condition of the patient.

The rule governing calculation of pediatric doses is Young's Rule as shown below:

$$\frac{\text{Age in years}}{\text{Age in years} + 12} \times \text{Adult dose} = \text{child's dose}$$

The age in years of the child is the numerator and the age plus 12 is the denominator. This fraction is multiplied by the normal adult dose.

Example: The adult dose of aspirin is 650 mg. What is the dose for a 3-year-old child?

$$\frac{3}{3 + 12} \times \frac{650 \text{ mg}}{15} = 130 \text{ mg}$$

Weight

In the calculation of dosages, weight has a more direct bearing on the dose than any other factor, especially in the calculation of pediatric doses. The rule governing calculation of pediatric doses based on weight is Clark's Rule shown below:

$$\frac{\text{Weight of child (pounds)}}{150 \text{ pounds}} \times \text{Adult's dose} = \text{Child's dose}$$

The weight in pounds is the numerator and the average adult weight, 150 pounds, is the denominator. This fraction is multiplied by the adult dose.

Example: The adult dose of aspirin is 650 mg. What is the dose for a child weighing 60 pounds?

$$\frac{60 \text{ pounds}}{150 \text{ pounds}} \times 650 \text{ mg} = 260 \text{ mg}$$

Other factors that influence dosage are:

1. Sex. Females usually require smaller doses than males.
2. Race. Blacks usually require larger doses and Asians smaller doses than Caucasians.
3. Genetic make-up. The genetic structure of the individual may cause peculiar reactions to medications in some patients.
4. Occupation. Persons working in strenuous jobs may require larger doses than those who sit at a desk all day.
5. Habitual use. Some patients must take medications chronically, causing their bodies to build up tolerance to the drug. This tolerance may require larger doses than their initial doses to obtain the same therapeutic effect.
6. Time of administration. Therapeutic effect may be altered depending upon time of administration, Example: Before or after meals.
7. Frequency of administration. A drug given frequently may need a smaller dose than if administered at longer intervals.

8. Mode of administration. This has a definite impact on the dose. Example: Injections may require smaller doses.

METHODS OF ADMINISTERING DRUGS

Drugs are introduced into the body by different routes, each serving a specific purpose.

Oral

Oral administration of medications is the most common method. Advantages are (1) convenience, (2) economy, (3) the drug need not be absolutely pure or sterile, and (4) a wide variety of dosage forms are available. Oral medications include tablets, capsules, liquids, and suspensions. Disadvantages include (1) inability of some patients to swallow, (2) slow absorption, and (3) partial or complete destruction by the digestive system. Other routes associated closely with oral administration are SUBLINGUAL and BUCCAL.

- Sublingual—The drug is placed under the tongue and rapidly absorbed directly into the blood stream. Example: Nitroglycerin sublingual tablets
- Buccal—The drug is placed between the cheek and gum and is quickly absorbed directly into the blood stream.

Parenteral

Parenteral medications are those introduced by injection. All drugs used by this route must be pure, sterile, pyrogen-free (pyrogens are products of the growth of microorganisms), and in a liquid state. There are several types of parenteral administration.

- Subcutaneous—The agent is injected just below the skin's cutaneous layers. Example: Insulin
- Intradermal—The drug is injected within the dermis. Example: Purified protein derivative (PPD)
- Intramuscular—The drug is injected into the muscle. Example: Procaine penicillin G
- Intravenous—The drug is introduced directly into the vein: Example: Intravenous fluids
- Intrathecal/intraspinal—The drug is introduced into the subarachnoid space of the spinal column.

Inhalation

Inhalation is the introduction of medications through the respiratory system in the form of a gas, vapor, or powder. Inhalation is divided into three major types:

- Vaporization —This is where the drug is changed from a liquid or solid to a gas or vapor by the use of heat, such as steam inhalation.
- Gas inhalation—It is almost entirely restricted to anesthesia.
- Nebulization—The drug is nebulized into minute droplets by the use of compressed gas.

Topical

Ointments, creams, lotions, and shampoos are examples of topical preparations. Topical application serves two purposes: (1) local effect-the drug is intended to relieve itching, burning, or other skin conditions without being absorbed into the bloodstream and (2) systemic effect—the drug is absorbed through the skin into the bloodstream. Example: Nitroglycerin paste

Rectal

The rectal method is preferred to the oral route when there is danger of vomiting or when the patient is unconscious, uncooperative, or mentally incapable.

Vaginal

Suppositories, creams, or tablets are examples of vaginal preparations which are inserted into the vagina to produce a local effect.

DRUG CLASSIFICATIONS

The definition of a drug is any chemical substance that has an effect on living tissue but

is not used as a food. Drugs are used on or administered to humans or animals as an aid in the diagnosis, treatment, or prevention of disease or other abnormal condition, for the relief of pain or suffering, or to control or improve any physiologic or pathologic condition. A drug may be classified in various categories, depending upon different criteria. Examples are general, chemical, and therapeutic.

- General—Drugs are grouped according to their source, whether animal, vegetable, or mineral in origin.
- Chemical—Medications are grouped by their chemical characteristics. Examples are acids, bases, or salts.
- Therapeutic (Pharmacological)—Drugs are classified according to their action on the body. A drug may have more than one action.

NOMENCLATURE

Drugs normally have three different names: chemical, generic, and trade (brand).

- Chemical name—Tells the chemical and molecular structure. An example is 2, 4, 7-triamino-6-phenylpteridine.
- Generic name—Often derived from the chemical name, it is the common name of the drug. An example is Triamterene. Note the underlining of the chemical name above.
- Trade name—This is the name given by the manufacturer and is a proprietary name, it is also called the brand name. An example is Dyrenium, a brand of triamterene made by Smith, Kline, and French.

DRUG GROUPS

The drugs discussed in this chapter are those in common use, or are in the Medical Stock List, and are grouped according to pharmacological classes. Only a brief summary is possible here and the corpsman who desires a more complete study of each drug should refer to the USP-NF or other reference books indicated at the end of this chapter.

ANTACIDS

Antacids are drugs used to counteract hyperacidity in the stomach. Normally, there is a certain degree of acidity in the stomach. An excess of acid can irritate the mucous membranes and is commonly known as indigestion, heartburn, or dyspepsia. In some disease states, the gastrointestinal tract may become excessively acidic (very low pH), causing diarrhea or leading to peptic ulcer formation. Antacids may interfere with the body's ability to utilize many drugs. For this reason, most oral drugs should not be taken within 2 hours of taking an antacid. NOTE: As a hospital corpsman, it is important to be aware of the significance of the sodium content of most antacids, particularly in the cardiac patient or patients on a low sodium diet.

Magnesium Hydroxide (Milk of Magnesia USP)

ACTION AND USE.— Milk of magnesia reacts with gastric acid to form magnesium chloride and has a prolonged duration of action. It is preferably taken on an empty stomach with lots of fluid. Do not use when abdominal pain, nausea, or vomiting is present. Shake well. Prolonged use may result in kidney stones. It also has a laxative effect.

USUAL DOSE.— 5 to 10 ml four to six times a day, up to a maximum of 60 ml. Laxative dose is 15 to 30 ml.

Aluminum Hydroxide Gel (Ampoojel)

ACTION AND USE.— This drug is used in the management of peptic ulcer, gastritis, and gastric hyperacidity. The major advantage of this drug is that no systemic alkalosis is produced. It may cause constipation.

USUAL DOSE.— 15 ml four to six times daily between meals and at bedtime.

Alumina and Magnesia Oral Suspension (Maalox)

ACTION AND USE.— Alumina and magnesia oral suspension coats the stomach lining and neutralizes gastric acid. It is less constipating than aluminum hydroxide alone.

USUAL DOSE.— 5 to 20 ml 1 hour after each meal and at bedtime.

Alumina, Magnesia, and Simethicone Oral Suspension (Mylanta, Gelusil)

ACTION AND USE.— This drug coats the stomach lining, neutralizes gastric acid, and reduces flatulence.

USUAL DOSE.— 5 to 10 ml 1 hour after meals and at bedtime.

Magaldrate (Riopan)

ACTION AND USE.— Magaldrate is the same as alumina and magnesia oral suspension, but is has a lower sodium content.

USUAL DOSE.— 5 to 10 ml between meals and at bedtime.

ASTRINGENTS

Astringents are drugs that cause shrinkage of the skin and mucous membranes. They act by precipitating the proteins on the surface layer of the skin and mucus membranes. Their main use is to stop seepage, weeping, or discharge from mucous membranes.

Aluminum Acetate Topical Solution (Burow's Solution)

ACTION AND USE.— This drug is an astringent wet dressing for the relief of inflammatory conditions of the skin, such as poison ivy, swellings and bruises, insect bites, athlete's foot, or other environmental skin conditions and for superficial external otitis.

USUAL DOSE.— Topical, in a 1:10 to 1:40 solution.

Calamine Lotion

ACTION AND USE.— Calamine lotion is used in the treatment of various skin afflictions in the same way as aluminum acetate. It is an astringent and protective, which is used externally. It should not be applied to blistered, raw, or oozing areas of the skin.

USUAL DOSE.— Apply to the affected area two to four times daily and at bedtime.

ABSORBENTS

An adsorbent is a drug that attaches another substance to its surface. These drugs are used to adsorb undesirable substances.

Activated Charcoal USP

ACTION AND USE.— This drug forms an effective barrier between any remaining particulate material and the gastrointestinal mucosa, thus inhibiting gastrointestinal absorption. It is used as an emergency treatment in poisoning by most drugs and chemicals.

USUAL DOSE.— 30 to 100 g within 30 minutes after ingestion of toxic substances. It is administered as a slurry and ingested by the patient or administered through a nasogastric or lavage tube.

EMOLLIENTS

Emollients are bland or fatty substances that may be applied to the skin to make it more pliable and soft, and may also serve as vehicles for application of other medicinal substances. They are available as ointments, creams, or lotions. Examples not discussed include Keri-Lotion, Eucerin-Lotion, and Lubriderm.

Cocoa Butter (Theobroma Oil)

ACTION AND USE.— Cocoa butter is an excellent emollient with a pleasant odor. It is ideal for the treatment of chapped skin and lips, cracked nipples, or minor irritated or abraded skin areas.

Hydrous Wool Fat (Lanolin)

ACTION AND USE.— This is a smooth creamy ointment of wool fat. It is an ideal emollient for dry, scaly skin conditions.

Petrolatum (Petroleum Jelly)

ACTION AND USE.— Petrolatum is a highly occlusive and good emollient. It may not release some drugs when used as an ointment base.

Zinc Oxide Ointment

ACTION AND USE.— This is a white petrolatum containing approximately 20 percent zinc

oxide powder. It is used as an emollient with slightly astringent properties, and because of its opaqueness it is ideal for protecting sensitive skin from the sun.

EXPECTORANTS AND ANTITUSSIVES

Expectorants, more accurately known as bronchomucotropic agents, are drugs used to assist in the removal of secretions or exudate from the trachea, bronchi, or lungs. They act by liquifying viscid mucus or mucopurulent exudates, i.e., they are decongestants. Therefore, they are used in the treatment of coughs to help expel these exudates and secretions. Antitussives are agents that specifically inhibit or suppress the act of coughing. They should not be used to suppress productive coughing. Expectorants and antitussives are most commonly used in the symptomatic treatment of the common cold or bronchitis. Other cold and allergy relief preparations are discussed later in this chapter.

Guaifenesin (Robitussin)

ACTION AND USE.— Guaifenesin is an expectorant. It may be useful in the symptomatic relief of dry, nonproductive coughs and in the presence of mucous in the respiratory tract.

USUAL DOSE.— 5 to 20 ml every 4 to 6 hours.

Dextromethorphan (DM)

ACTION AND USE.— This is a synthetic non-narcotic derivative of codeine that acts as an antitussive. It is used to control nonproductive coughs by soothing minor throat and bronchial irritations.

USUAL DOSE.— 5 to 15 ml (10 to 30 mg) every 6 to 8 hours. It is frequently combined with Guaifenesin (Robitussin).

Benzonatate (Tessalon Perles)

ACTION AND USE.— Benzonatate is an antitussive. It anesthetizes the stretch receptors located in the respiratory passages and lungs, reducing the cough reflex at its source. It is used for the symptomatic relief of nonproductive coughs.

USUAL DOSE.— One perle three times daily as needed, up to 600 mg a day.

Terpin Hydrate Elixir with Codeine (ETH with Codeine)

ACTION AND USE.— Codeine is a narcotic antitussive. The terpin hydrate is used primarily as a vehicle for the codeine but has a mild expectorant effect. This product contains 40 percent alcohol which serves as the main bronchomucotropic agent.

USUAL DOSE.— 5 ml every 3 to 4 hours.

ANTISEPTICS, DISINFECTANTS, AND GERMICIDES

These drugs are primarily intended for the prevention of infections by destroying bacteria or preventing their growth. The differences among them are based primarily on degree of activity and how they are used; antiseptics suppress the growth of microorganisms and are used topically; germicides kill susceptible organisms; and disinfectants are agents used on inanimate objects and are primarily germicidal in their action. All of these agents are for external use only unless otherwise indicated.

Phenol (Carbolic Acid)

Historically one of the first antiseptic agents used, phenol is the standard by which all other antiseptic, disinfectant, and germicidal agents are measured in their effectiveness. Because of its highly caustic nature, it must be handled with care. The effect of phenol is coincident with the concentration; high concentrations are germicidal and can cause tissue destruction; lower concentration are antiseptic. Phenol is inactivated by alcohol. Because more effective and less damaging agents have been developed, phenol is no longer used extensively. Never use phenol to disinfect rubber, cloth, or plastic.

Povidone-Iodine (Betadine)

ACTION AND USE.— Numerous iodine and iodine complex agents are available for use in disinfection. The most common of these is povidone-iodine (Betadine). It is used externally to destroy bacteria, fungi, viruses, protozoa, and yeasts. It is relatively nontoxic, nonirritating, and nonsensitizing to the skin. When used as an antiseptic, the complex breaks down on contact with skin or mucous membranes to release free iodine which is slowly absorbed. It is most commonly used as a preoperative skin antiseptic.

Isopropyl Alcohol (Isopropanol)

ACTION AND USE.— This is used in a 70 percent solution as a skin antiseptic; it is volatile and also has a desiccating (drying) effect on the skin.

Hexachlorophene (pHisoHex)

ACTION AND USE.— A synthetic preparation, hexachlorophene is a bacteriostatic cleansing agent most effective against gram positive organisms. Pus or serum decrease the efficacy. Hexachlorophene is a neurotoxic agent and must not be used on premature infants, denuded skin, burns, or mucous membranes. It is used as an antiseptic scrub by physicians, dentists, food handlers, and others. Residual amounts can be removed by alcohol.

Silver Nitrate

ACTION AND USE.— The soluble salts of silver ionize in water to produce solutions that are astringent and antiseptic in high concentration. In solid form, silver nitrate is most commonly used to cauterize mucous membranes or treat aphthous ulcers. The most common side effect is the skin turns black where the silver nitrate has come into contact with it. This black area is slow to absorb but is not harmful. In liquid form, it is used to prevent gonorrhea ophthalmia in the newborn (eye drops) or as a wet dressing on burns. Caution must be taken to keep the dressing wet; silver will precipitate from a drying dressing and can be absorbed through the skin. The effect is a condition known as agyria, where the skin turns a slate gray. There is no known reversal for this condition.

Benzalkonium Chloride (Zephiran Chloride)

ACTION AND USE.— A somewhat effective, non-injurious surface disinfectant, benzalkonium chloride is germicidal for a number of gram-positive and gram-negative organisms including some fungi. It is inactivated by soap or alcohol, and is not effective against spores or viral pathogens. It is most commonly used as a cleansing agent in animal bites.

Glutaraldehyde (Cidex)

ACTION AND USE.— Glutaraldehyde is effective against vegetative gram-positive, gram-negative, and acid-fast bacteria, bacterial spores, some fungi, and viruses. It is used in an aqueous solution for sterilization of fiber optics, plastics, rubber, and other materials that are not resistant to heat.

Thimersol (Merthiolate)

ACTION AND USE.— An organic mercury compound, thimersol is non-irritating to the skin and mucus membranes when applied topically. It has antiseptic, germicidal, and fungicidal properties.

Hydrogen Peroxide

ACTION AND USE.— Certain oxidizing agents are destructive to pathogenic organisms but mild enough to be used on living tissue. Hydrogen peroxide is a germicide that is active by the release of oxygen. It deteriorates on standing to oxygen and water. It is most commonly used to clean suppurating wounds, and is also efficious in the treatment of Vincent's angina (trench mouth). For external use only, it is available as a 3 percent solution.

ANTIINFECTIVES

Antibiotics are chemical compounds produced as the result of metabolic activity of microorganisms or produced synthetically. They inhibit the growth of susceptible microorganisms or kill them through the destruction of necessary enzymes. Antibiotics that are sufficiently non-toxic to the host are used as chemotherapeutic agents in the treatment of infectious diseases of man, animals, and plants. They can be administered orally, topically, or parenterally.

Antibacterial Agents

The five basic mechanisms of action for the antimicrobial agents are (1) inhibition of the synthesis of the bacterial cell wall, (2) affecting the cell wall permeability, (3) inhibition of protein synthesis by affecting ribosomal activity, (4) affecting nucleic acid metabolism, and (5) the antimetabolites that compete with necessary enzymes. To be of practical value in the treatment of infection, an antimicrobial agent must exert it effects upon the invading microorganism without seriously damaging the cells of the host. The following are groups of antimicrobial agents and their general mechanisms of action.

SULFONAMIDES

The sulfonamides were the first effective chemotherapeutic agents to be available in safe therapeutic dosage ranges. They were the mainstay of therapy of bacterial infections in humans before the introduction of the penicillins in 1941. All the sulfonamides are synthetically produced and contain the para-amino-benzene sulfanilamide group. The spectrum of activity for all the sulfonamides is similar and all are effective against both gram-positive and gram-negative organisms. They are primarily bacteriostatic and act as an antimetabolite (competitor) to para-aminobenzoic acid (PABA) in susceptible organisms. PABA is required in the formation of folic acid.

Excretion of the sulfonamides is chiefly through the kidneys. Some of the sulfonamides are relatively insoluble in acidic or neutral solutions so there is some danger that a sulfonamide would precipitate out of solution leading to crystal formation, hematuria, or possibly renal shutdown. Forcing fluids to keep the urine dilute or administering alkaline solutions can help to prevent precipitation of sulfonamides. With the newer sulfonamides, this is not a major concern since many of them are soluble in acidic solutions.

Although the sulfonamides have, for the most part, been replaced with other agents, there is still a significant demand in certain types of infection, most notable urinary tract infections, such as acute cystitis or prostatitis, and in cases of acute otitis media. The following lists some of the more common sulfonamides.

Sulfisoxazole (Gantrisin)

ACTION AND USE.— This systemic sulfonamide is bacteriostatic and is indicated in the treatment of urinary tract infections and acute otitis media.

USUAL DOSE.— 2 to 4 g initially, then 1 to 2 g four times daily for 10 days. The patient should be advised to increase fluid intake.

Trimethoprim and Sulfamethoxazole (Bactrim, Septra)

ACTION AND USE.— This is an antiinfective combination used in the treatment of urinary tract infections and otitis media. Both drugs are effective antimetabolites but compete at different steps in the formation of PABA. In combination, they are more effective than individually.

USUAL DOSE.— Two tablets every 12 hours. The patient should be advised to increase fluid intake.

Sulfacetamide (Sulamyd)

ACTION AND USE.— Sulfacetamide is an ophthalmic bacteriostatic for the treatment of conjunctivitis, corneal ulcer, and other superficial ocular infections. It is available in solutions of various strengths and in an ointment form. Sulfacetamide is inactivated by the para-aminobenzoic acid in purulent exudates.

USUAL DOSE.— Solutions of 1 to 2 drops three or four times daily depending on the severity of the infection. The ointment should be applied four times daily.

Silver Sulfadiazine (Silvadene)

ACTION AND USE.— Silver sulfadiazine is a topical antimicrobial agent used in the treatment of second- and third-degree burns to prevent wound sepsis. [t is water soluble and easily washed off the skin.

USUAL DOSE.— Silver sulfadiazine is available in an emollient cream and should be initially applied to a burn wound twice daily in a sterile manner. For each dressing change, the burn wound should be debrided of any dead or sloughing tissues and carefully cleaned to remove any residual purulent exudate.

PENICILLINS

Penicillin is one of the most important of the antibiotics. It is derived from a number of *Penicilliumm* molds commonly found on breads and fruit. The mechanisms of action for the penicillins is the inhibition of cell wall synthesis during the reproductive phase of bacterial growth. It is one of the most effective and least toxic of the antimicrobial agents.

Benzylpenicillin (Penicillin G) is the prototype form for all the penicillins. It is highly effective against many of the gram-positive cocci, and, to a lesser extent, the gram-negative cocci. Semisynthetic preparations have been produced to attempt to overcome some of the problems of the naturally occurring penicillins, i.e., instability in an acid medium, rapid renal excretion, susceptibility to penicillinase, and a high incidence of hypersensitivity. Significant differences among the agents

include resistance to gastric acid inactivation, resistance to inactivation by penicillinase, and the spectra of antimicrobial activity.

Although the penicillins are virtually nontoxic to mammalian cells, there is a significant incidence of anaphylaxis in varying degrees. Reactions include skin rash, contact dermatitis, mild gastrointestinal upset, oral lesions, and fever. Because of the basic structure, there is a high degree of cross-sensitivity among the various forms.

Penicillin is effective in the treatment of:

- Bacterial endocarditis and pneumococcal infections
- Hemolytic streptococcal infections
- Clostridial infections such as gas gangrene
- Anaerobic streptococcal infections
- Gonococcal infections
- Anthrax
- Vincent's angina
- Syphilis
- Rheumatic heart fever

Penicillin G (Aqueous)

ACTION AND USE.— Penicillin G is indicated for susceptible infections as listed under the discussion of penicillins. It is available as a potassium or sodium salt and is for parenteral use only.

USUAL DOSE.— The dosage varies with the infection. Doses of 10 million units or higher should be given by intravenous infusion only.

Penicillin G Procaine, Aqueous (Wycillin)

ACTION AND USE.— Penicillin G procaine is indicated for deep intramuscular usage only in susceptible infections as listed under the discussion of penicillins. The action is more prolonged than penicillin G.

USUAL DOSE.— For uncomplicated gonorrhea, 4.8 million units intramuscularly at two sites with 1 g of probenicid orally. Other dosages are as prescribed by the physician.

Penicillin G Benzathine (Bicillin)

ACTION AND USE.— This drug is indicated for deep intramuscular usage in susceptible infections. It has a longer duration of action than most of the other penicillins.

Penicillin V Potassium (Phenoxymethyl Penicil]in) (Pen-Vee K, Betapen-VK, V-Cillin K)

ACTION AND USE.— Penicillin V is used in the treatment of susceptible infection as listed under the discussion of penicillins. It is available as oral tablets or powder for reconstitution for oral suspension. It is more stable in acid media than most of the other penicillins. It has the same spectra of activity of penicillin G and is usually the drug of choice for uncomplicated group A beta-hemolytic streptococcal infections.

Dicloxicillin (Dynapen)

ACTION AND USE.— This drug is a penicillinase-resistant penicillin effective in treating penicillinase-producing staphylococci. It may be used to initiate therapy in any patient in whom a staphylococcal infection is suspected.

USUAL DOSE.— 250 to 500 mg every 6 hours. It is available in capsules or powder form for oral suspension.

Ampicillin (Polycillin, Omnipen, Totacillin)

ACTION AND USE.— Ampicillin is relatively stable in an acid medium and is readily absorbed after oral ingestion. It is effective against gram-negative and gram-positive cocci and some gram-negative bacilli. It is available in both oral and parenteral forms.

USUAL DOSE.— The range is 250 to 500 mg every 6 hours, depending upon the diagnosis. For the parenteral dosage, normal saline is the recommended diluent.

Methicillin Sodium (Staphcillin)

ACTION AND USE.— Methicillin is a penicillinase-resistant drug reserved for treatment of penicillinase-producing staphylococcal organisms. It is administered parenterally only.

USUAL DOSE.— 1 g every 6 hours as directed by the physician, intramuscularly or intravenously.

Nafcillin (Nafcil, Unipen)

ACTION AND USE.— Nafcillin is stable in acidic solution, soluble in water, and readily absorbed. Its action and effect are similar to the other penicillinase-resistant penicillins. Like methicillin, nafcillin is reserved for penicillinase-producing staphylococcal infections and should not be used for organisms susceptible to penicillin G.

USUAL DOSE.— 500 mg or 1 g every 4 to 6 hours as directed by the physician.

CEPHALOSPORINS

The cephalosporins are a group of semisynthetic derivatives of *cephalosporin C,* an antimicrobial agent of fungal origin. They are structurally and pharmacologically related to the penicillins. Because the cephalosporins are structurally similar to the penicillins, some patients allergic to penicillin may be allergic to a cephalosporin drug. The incidence of cross-sensitivity is estimated to be 5 to 16 percent. Their antibacterial activity is due to inhibition of cell wall synthesis.

This family of antibiotics is generally divided into generations: first generation, cephadrine and cefazolin; second generation, cefoxitin, and third generation, cefotaxime. The main differences between groups is the change in the antibacterial spectrum. The third generation agents have a much broader gram-negative spectrum than the earlier generations.

Cefazolin (Ancef, Kefzol)

ACTION AND USE.— Cefazolin is indicated for susceptible infections due to *Streptococcus pneumonia, Klebsiella, Hemophilus influenza, Staphylococcus aureus, E. coli,* and preoperative prophylaxis.

USUAL DOSE.— It may be given intramuscularly or intravenously from 250 to 500 mg every 8 hours; 1 to 1.5 g every 6 hours in life-threatening infections.

Cephadrine (Anspor, Velosef)

ACTION AND USE.— Cephadrine is indicated for certain respiratory tract infection, otitis media, certain urinary tract infections, infections of the skin and skin structures, and other susceptible infections.

USUAL DOSE.— It may be given parenterally or orally. Orally, give 250 mg every 6 hours or 500 mg every 12 hours. Parenterally, give 2 to 4 g in equally divided doses four times daily intramuscularly or intravenously.

Cefoxitin (Mefoxin)

ACTION AND USE.— Cefoxitin is used in the treatment of susceptible gram-positive and gram-negative bacteria.

USUAL DOSE.— 1 or 2 g every 6 to 8 hours.

Cephalexin (Keflex)

ACTION AND USE.— Cephalexin is an oral preparation indicated for the treatment of certain respiratory tract infections including group A beta-hemolytic streptococci, otitis media, certain urinary tract infections, osteitis, infections of the skin and skin structures, and other susceptible infections.

USUAL DOSE.— 250 to 500 mg four times daily.

Cephalothin (Keflin)

ACTION AND USE.— Cephalothin is a broad-spectrum parenteral preparation indicated for serious infections caused by susceptible microorganisms specifically S. *pneumonia, P. mirabilus, Klebsiella,* and *E. coli.* It is also indicated as a prophylactic measure in certain surgical procedures that are considered contaminated or potentially contaminated.

USUAL DOSE.— The usual dose is 500 mg to 1 g every 4 to 6 hours; 500 mg every 6 hours is usually adequate in uncomplicated infections.

TETRACYCLINES

The tetracycline, introduced in 1948, were the first truly broad-spectrum antibiotics. They include a large group of drugs with a common basic

structure and chemical activity. The most important mechanism of action of the tetracycline is blocking the formation of polypeptides used in protein synthesis. Because of their broad spectrum of activity, tetracycline are most valuable in the treatment of mixed infection, such as chronic bronchitis and peritonitis; however, they are drugs of choice for only a few bacterial infections. Tetracycline is also used as a topical preparation in the treatment of acne.

The tetracycline are relatively non-toxic, the most common side effects being mild gastrointestinal disturbances; allergic reactions and anaphylaxis are rare. Administration to children and pregnant women is not indicated because it may produce discoloration of the teeth and depress bone marrow growth. The major hazard of tetracycline therapy is the overgrowth of resistant organisms, especially Monilia and staphylococci.

Tetracycline should not be administered with milk, milk products, antacids or iron preparations; they combine with metal ions to form nonabsorbable compounds.

Tetracycline Hydrochloride (Achromycin)

ACTION AND USE.— Tetracycline hydrochloride (TCN) is used in the treatment of infections caused by Rickettsiae (Rocky Mountain spotted fever, typhus fever), agent of lymphogranulomas venereum and granuloma inguinale, and the spirochetal agent of relapsing fever. It is also indicated for certain gram-negative microorganisms. Tetracycline hydrochloride is indicated for severe acne as an adjunctive therapy. Food and some dairy products may interfere with absorption; antacids containing aluminum, calcium, or magnesium impair absorption of the antibiotic as well. Give the drug 1 hour before or 2 hours after meals.

USUAL DOSE.— 1 or 2 grams per day in two or four equal doses, depending on the severity of the infection.

Doxycycline Hyclate (Vibramycin)

ACTION AND USE.— Doxycycline is active against a wide range of gram-positive and gram-negative microorganisms and has a low affinity for binding with calcium. In addition to the conditions listed under tetracycline, doxycycline is also indicated for the treatment of uncomplicated chlamydial infections and uncomplicated gonococcal infections.

USUAL DOSE.— For most uncomplicated infections, 200 mg the first day followed by a maintenance dose of 100 mg per day for 7 to 10 days. For venereal diseases, 200 mg per day for 7 days in equally divided doses; for syphilis, 300 mg per day in equally divided doses for 10 days. Intravenous infusion is indicated only when the oral route is not indicated.

Minocycline Hydrochloride (Minocin)

ACTION AND USE.— Minocycline hydrochloride is indicated for the same conditions as tetracycline hydrochloride and doxycycline hyclate.

USUAL DOSE.— The dosage ranges are the same as for doxycycline hyclate.

AMINOGLYCOSIDES

The aminoglycosides are a group of drugs sharing chemical, antimicrobial, pharmacologic, and toxic characteristics. They are effective against most gram-positive and gram-negative organisms; the method of action is by inhibiting protein synthesis. Aminoglycosides can cause varying degrees of otototicity and nephrotoxicity, depending on the particular agent and the dose. Toxicity is more prevalent in the presence of renal impairment, in the very young or old, dehydration, or with the use of diuretics. Because of their high toxicity, they are not recommended when the infective organism is susceptible to less toxic preparations.

Streptomycin Sulfate

ACTION AND USE.— Streptomycin sulfate is indicated for all forms of *mycobacterium tuberculosis;* it should be used only in conjunction with other antituberculosis drugs, i.e., rifampin or isoniazid. It is also indicated in the treatment of plague, tularemia, chancroid, granuloma inguinale and some urinary tract infections where the infectious agent has shown to be susceptible to streptomycin and not susceptible to less toxic preparations.

USUAL DOSE.— The dosage ranges from 1 to 4 g daily depending on the disease condition and the condition and age of the patient. Streptomycin is for intramuscular use only.

Neomycin Sulfate

ACTION AND USE.— Neomycin sulfate is effective against certain gram-negative and gram-positive bacteria. Normally used as a topical preparation for the treatment of skin infections, burn wounds, ulcers, and dermatoses, it may be used orally for reduction of intestinal flora prior to surgery involving the bowel or anus.

USUAL DOSE.— 700 mg every 4 hours as prescribed by a physician.

Gentamycin Sulfate (Garamycin)

ACTION AND USE.— Gentamycin sulfate is indicated in the treatment of serious systemic infections of susceptible gram-negative organisms. While the patient is on gentamycin, it is necessary to monitor renal and hepatic function to determine if toxic levels are reached. Gentamycin is also available as a topical preparation for the treatment of burns and infected wounds, and as an ophthalmic preparation for eye infections.

USUAL DOSE.— The recommended dose for patients with serious infections and normal renal function is 3 mg/kg/day in equally divided doses. Gentamycin is normally administered intramuscularly but can be administered intravenously.

MACROLIDES

The macrolide antibiotics constitute a large group of bacteriostatic agents that inhibit protein synthesis. They are effective against gram-positive cocci, *Neisseria, Hemophilus,* and mycobacteria. All are similar to penicillin in their antibacterial spectra and are often used in patients who are sensitive to penicillin.

Erythromycin (Ilotycin, Erythrocin, E-Mycin)

ACTION AND USE.— Because it has a bitter taste and is destroyed by gastric acids, erythromycin is usually administered as an enteric coated tablet. Erythromycin is one of the drugs of choice when penicillin is contraindicated. It is also available as an ophthalmic ointment and as a topical preparation for the adjunctive treatment of acne.

USUAL DOSE.— 250 mg four times daily or 500 mg twice daily for oral preparations, and 1 g daily by slow intravenous infusion or in four equally divided doses.

Clindamycin Hydrochloride (Cleocin)

ACTION AND USE.— The use of clindamycin hydrochloride has often been associated with severe colitis and profuse diarrhea; if this condition occurs, the drug should be discontinued. Clindamycin hydrochloride is indicated in the treatment of susceptible anaerobic organisms. A topical preparation is also available for the treatment of acne.

USUAL DOSE.— 150 to 300 mg every 6 hours for the oral form and 600 to 1200 mg per daily in 2, 3, or 4 equally divided doses for the intravenous form.

Vancomycin Hydrochloride (Vanocin)

ACTION AND USE.— Vancomycin hydrochloride is bactericidal against many gram-positive bacteria. It is indicated in potentially life-threatening conditions that cannot be treated with less toxic preparations.

USUAL DOSE.— 500 mg every 6 hours or 1 g every 12 hours intravenously only; vancomycin hydrochloride can be very irritating and painful when administered intramuscularly.

MISCELLANEOUS ANTIBIOTICS

In addition to the previously mentioned antiinfectives, there are several other agents that are effective in the treatment of different organisms.

Rifampin (Rifadin)

ACTION AND USE.— Rifampin is indicated in the treatment of pulmonary tuberculosis; it must be used in conjunction with at least one other antituberculosis agent, usually ethambutol or isoniazid.

USUAL DOSE.— 600 mg in a single daily administration throughout the course of the disease.

Isoniazid (INH)

ACTION AND USE.— Isoniazid is indicated in the treatment of tuberculosis and as a preventive therapy for high risk persons, i.e., positive tuberculin skin test, family members of a person with tuberculosis, and newly infected persons.

USUAL DOSE.— 300 mg daily in a single dose. Because the relapse rate is high, it is essential that the treatment regimen be continued for a sufficient period of time; routinely, this is considered to be 1 year for preventive therapy.

Chloramphenicol Sodium Succinate (Chlorornycetin)

ACTION AND USE.— Chloramphenicol was used extensively when first developed because it had no apparent side effects. It inhibits protein synthesis, is easily absorbed from the gastrointestinal tract, and is effective against most gram-positive and gram-negative organisms, and against rickettsiae. Chloramphenicol has been recognized as highly toxic with significant hematologic side effects; i.e., bone marrow depression, anemia, and leukopenia. Currently, it is normally used only for treatment of typhoid and other salmonella, rickettsial diseases, and gram-negative bacteremia resistent to other antibiotics. Because of its serious toxic effects, it is reserved for serious infections that are not amenable to treatment with less toxic preparations.

USUAL DOSE.— 50 mg/kg/day in divided doses at 6 hour intervals. The oral method is the preferred method of administration although intravenous infusion is acceptable; intramuscular injection is ineffective.

Polymixin B Sulfate (Aerosporin) and Polymixin E Sulfate (Coly-Mycin S)

ACTION AND USE.— These are the only polymixin complexes still in use. Because of their excessive nephrotoxic nature, the other polymixin complexes have been discarded. Polymixins act by disrupting the cytoplasmic membrane of the cell causing immediate cell death. The polymixins are bactericidal against almost all the gram-negative bacilli; they are not effective against gram-positive bacteria or fungi.

USUAL DOSE.— Polymixin B sulfate is available as a parenteral preparation for intravenous or intrathecal administration; it should not be used intramuscularly. The dosage is 15,000 to 25,000 units/kg/day intravenously; 1 to 3 drops of a 0.1 to 0.25 percent solution hourly for the treatment of conjunctivitis. The preparation can also be used as an ophthalmic solution. Polymixin E sulfate (colistin) is available as an oral suspension for the treatment of diarrhea in children given at 5 to 15 mg/kg/day. It is also available as an otic suspension with neomycin and hydrocortisone for the treatment of superficial bacterial infections of the external auditory canal. The dose is 4 drops 3 or 4 times daily.

Spectinomycin Hydrochloride (Trobicin)

ACTION AND USE.— Spectinomycin was developed with the sole therapeutic indication being the treatment of gonorrhea. It is largely bacteriostatic and quite effective in the treatment of uncomplicated gonorrhea. Its advantage lies primarily in being a single dose therapy and in patients who are allergic to penicillin or have penicillin resistant strains of the causative organism. It is NOT effective in the treatment of syphilis.

USUAL DOSE.— An intramuscular dose of 2 g is recommended. In areas of the world where antibiotic resistance is known to exist, the recommended dose is 4 g in a single dose in two injection sites.

Nitrofurantoin (Furadantin, Macrodantin)

ACTION AND USE.— Nitrofurantoin is effective against a wide range of gram-positive and gram-negative organisms, protozoa, and fungi. It is rapidly and completely absorbed from the intestine but has little or no systemic effect because it is rapidly excreted through the kidneys. Its usefulness is limited to urinary tract infections where the drug attains concentration in the urine to which most organisms are sensitive. Macrodantin is a preparation of nitrofurantoin where the crystals are of a controlled size.

USUAL DOSE.— Nitrofurantoin is used in the treatment of pyelonephritis, pyelitis, and cystitis. Normal dose is 50 to 100 mg 4 times daily; it should be given with meals to increase absorption and minimize gastrointestinal upset. It is contraindicated where significant renal impairment exists.

Phenazopyridine (Pyridium)

ACTION AND USE.— Although not an antiinfective, phenazopyridine is included here because it is used almost exclusively in urinary tract infections. Phenazopyridine is a urinary tract analgesic indicated for the symptomatic relief of discomforts arising from irritation of the lower

tract mucosa. Phenazopyridine is excreted in the urine where it exerts a topical anesthetic effect on the mucosa of the urinary tract. It is contraindicated where renal insufficiency exists. Phenazopyridine imparts a bright red or orange color to the urine and the patient should be made aware of this fact.

USUAL DOSE.— 200 mg three times daily after meals.

Bacitracin

ACTION AND USE.— This bactericide is effective against a wide variety of organisms. Its mode of action is the inhibition of bacterial cell wall synthesis. It is not effective against most aerobic gram-negative bacilli and is employed locally by topical application in ointment form.

ANTIFUNGAL

Antifungal agents inhibit or suppress the growth systems of fungi, dermatophytes, or *Candida.* Antifungal have not been developed to the same degree as antibacterial agents. Most fungi are completely resistant to the action of chemicals at concentrations that can be tolerated by the human cell. Since there are only a few available for internal use, most antifungal agents are topical. The agents that are available for systemic use generally produce hepatic or renal dysfunction or other serious side effects; because of this, systemic antifungal should be limited to serious or potentially fatal conditions. When using oral or parenteral antifungal agents, provide concomitant therapy with topical preparations.

Nystatin (Mycostatin)

ACTION AND USE.— Nystatin is primarily used in the treatment of candidal infections. It is fungicidal and fungistatic against a wide variety of yeasts and yeast-like fungi and most often used in the treatment of candidiasis. It is sometimes used concurrently with tetracycline to suppress the overgrowth of *Candida* in the bowel.

USUAL DOSE.— Nystatin is available as a cream, powder, oral tablets, vaginal tablets, or oral suspension. The cream or powder should be applied two or three times daily as indicated by clinical response; one or two oral tablets three times daily until 48 hours after clinical cure; vaginal tablets one daily for 2 weeks; and the oral suspension 2 to 4 ml four times daily held in the mouth for as long as possible before swallowing.

Griseofulvin (Gris-Peg, Fulvicin)

ACTION AND USE.— Griseofulvin is a fungistatic agent used in the treatment of fungal infections of the nails, hair, and skin. It is generally reserved for chronic infections that have not responded to topical therapy alone. Because treatment may last for several months, the patient should be instructed to follow the treatment regimen even though symptoms may abate. Inclusion of topical therapy is a must for effective elimination of the infection. Griseofulvin is not indicated for the treatment of superficial fungal infections that can be controlled by topical antifungal. Because of its toxicity, patients should have periodic evaluations of hepatic and renal function. Griseofulvin is contraindicated in patients with hepatic dysfunction.

USUAL DOSE.— 500 mg to 1 g daily as either a single dose or two equally divided doses.

Miconazole Nitrate (Monistat)

ACTION AND USE.— Miconazole nitrate is a synthetic antifungal that inhibits the growth of common dermatophytes. Is is indicated for the treatment of cutaneous fungal infections and vulvovaginal candidiasis.

USUAL DOSE.— For topical preparations, the cream should be applied to the affected area twice daily. For vaginal infections, either the cream or the suppository should be inserted daily at bedtime for 7 days.

Undecylenic Acid (Desenex)

ACTION AND USE.— This is a fatty acid antifungal, available in ointment, dusting powder, solution, and spray. It is used primarily in the treatment and prevention of tinea pedis (athlete's foot) and is often compounded with zinc to act as an astringent.

FOR TOPICAL USE.— Apply two to four times daily between the toes and on the affected areas.

Tolnaftate (Tinactin, Aftate)

ACTION AND USE.— Tolnaftate was the first fungicide synthesized. It is effective in the treatment of superficial fungal infections of the skin. It is indicated for the topical treatment of tinca pedis (athlete's foot), tinca corporis (body ringworm), tines capitis (fungus infection of the scalp), and tines versicolor.

USUAL DOSE.— It is for topical use only and is available in cream, gel, powder, and solution. Only small quantities are required for effective treatment. Apply twice daily to the affected area for 2 to 3 weeks.

Clotrimazole (Lotrimin, Mycelex)

ACTION AND USE.— This is a broad-spectrum antifungal that inhibits the growth of pathogenic dermatophytes, yeasts, and other types of fungus growth, including *Candida albicans.* It is indicated for the treatment of tinea pedis, tinea cruris, tines corporis, and candidiasis.

USUAL DOSE.— It is for topical use only. It is available in cream and solution. It is also available in a vaginal cream for the treatment of vulvovaginal candidiasis. Apply twice daily to the affected area for two weeks. A single daily vaginal application for two weeks is generally sufficient for cure.

ANTIPARASITICS

Parasitic infections or infestations account for the largest number of chronic disabling diseases known. They are especially prevalent in the tropics or subtropics and in lesser developed countries where overcrowding and poor sanitation exist. Parasitic infections include protozoal infections, i.e., malaria, amebiasis, and to a lesser extent, trichomoniasis; helminthic infections (intestinal worms), and ectoparasites. Ectoparasites, although not disabling, are considered a nuisance and can transmit disease.

Lindane (Kwell) (Old name: Gamma Benzene Hexachloride)

ACTION AND USE.— Lindane is a pediculocide used in the treatment of *Pediadosis capitis* (head lice) and *Phthirus pubis* (crab lice). It is also indicated for scabies. Use with caution, especially in infants, children, and pregnant women, since it penetrates human skin and has the potential for systemic poisoning. This drug is irritating to the eyes and should be discontinued immediately if local irritation occurs.

USUAL DOSE.— As a 1 percent cream, lotion, or shampoo, it is for topical use only. A single application is usually sufficient to kill parasites and their eggs, but it may be repeated in 7 days.

Crotamiton (Eurax)

ACTION AND USE.— This is a scabicide indicated for the treatment of scabies *(Sarcoptes scabiei);* it also has an antipruitic effect. Keep away from the eyes and mouth, and do not apply to inflamed skin.

USUAL DOSE.— For topical use only, it is available in a 10 percent cream or lotion. Thoroughly massage into the skin of the whole body from the chin down for scabies treatment. A second application is often advisable in 24 hours.

Metronidazole (Flagyl)

ACTION AND USE.— Metronidazole is effective in the treatment of all forms of amebiasis. It is also used as a trichomonacide.

USUAL DOSE.— For amebiasis, give 500 to 750 mg three times daily for 5 to 10 days. For trichomoniasis, give 2 g as a single dose or 250 mg three times daily for 7 days. Take with food or milk. **NOTE: DO NOT DRINK ANY ALCOHOLIC BEVERAGES; IT MAY CAUSE A "DISULFRAM" REACTION.** Metronidazole is contraindicated in pregnant women during the first trimester.

Chloroquine Phosphate (Aralen)

ACTION AND USE.— Chloroquine phosphate is the drug of choice in the treatment of acute malarial attacks and severe disease and in the prevention and suppression of malaria in endemic areas.

USUAL DOSE.— It is generally administered once a week while in an endemic area as a prophylactic agent.

Primaquine Phosphate

ACTION AND USE.— Primaquine phosphate is the drug of choice for the prevention or relapse of malaria caused by *P. vivax,* and *P. ovale.* Primaquine phosphate is contraindicated in G-6-PD deficient personnel as it may result in hemolytic anemia.

USUAL DOSE.— Primaquine phosphate is most commonly used as a terminal prophylaxis, i.e., it is given for 14 days after leaving an endemic area.

Fansidar (Sulfadoxine and Pyrimethamine)

ACTION AND USE.— Fansidar is used in the curative treatment of strains of malaria that are resistant to chloroquine phosphate. It is also used as a prophylaxis in endemic areas.

USUAL DOSE.— For the curative treatment, 2 or 3 tablets followed by two weeks of primaquine phosphate to prevent relapse. For the prophylactic treatment, one tablet weekly beginning two days prior to arrival in an endemic area and six weeks after leaving the area followed by a regimen of primaquine phosphate.

Mebendazole (Vermox)

ACTION AND USE.— Mebendazole is effective in treating infestations of hookworm, roundworm, pinworm, and whipworm.

USUAL DOSE.— For pinworms, a single 100 mg tablet is generally sufficient to effect cure. For whipworms, roundworms, and hookworms, a 100 mg tablet morning and evening for three consecutive days.

Pyrantel Pamoate (Antiminth)

ACTION AND USE.— This is regarded as the drug of choice for pinworm and roundworm infections.

USUAL DOSE.— A single dose of 1 ml (50 mg) per pound body weight. It maybe administered without regard to ingestion of food or time of day.

Thiabendazole (Mintezol)

ACTION AND USE.— Thiabendazole is a vermacide used to destroy pinworms, roundworms, threadworms, hookworms, and whipworms. It is not indicated as a prophylactic agent.

USUAL DOSE.— The dosage is based on the patient's weight. For persons over 150 pounds, 1.5 g two times daily for two days. For persons under 150 pounds, dosage is 10 mg per pound two times daily. The maximum daily dosage is 3.0 g.

Pyrvinium Pamoate (Povan)

ACTION AND USE.— Pyrvinium pamoate is indicated in the treatment of pinworms. To avoid undue concern, the patient should be informed that the drug will stain a bright red and stools will be a bright red.

USUAL DOSE.— Pyrvinium pamoate is administered in a single dose of 5 mg/kg body weight up to a maximum of 7 tablets of 50 mg each.

LAXATIVES

Laxatives are drugs that facilitate the passage and elimination of feces from the colon and rectum. They are indicated for the treatment of simple constipation and to clean the intestine of any irritant or toxic substances (catharsis). Laxatives may also be used to soften painfully hard stools and to lessen straining of certain cardiac patients when defecating. They are contraindicated in certain inflammatory conditions of the bowel, bowel obstruction, and abdominal pain of unknown origin, and should not be used in the presence of nausea and vomiting. Laxatives are classified as irritant, bulk, emollient, or stool softeners. Frequent or prolonged use of any laxative may result in dependence.

Mineral Oil

ACTION AND USE.— Mineral oil is an emollient laxative used to lubricate the fecal mass. It is often used in combination with an irritant agent such as phenophthalein.

USUAL DOSE.— 15 to 45 ml at bedtime.

Glycerin Suppositories NF

ACTION AND USE.— These are widely used in children. They promote peristalsis through local irritation of the mucous membrane of the colon.

USUAL DOSE.— Available in adult and children sizes. Insert 1 suppository rectally as needed. Retain for 15 minutes; it does not need to melt to produce laxative action.

Bisacodyl (Ducolax)

ACTION AND USE.— Bisacodyl is a relatively non-toxic irritant cathartic that reflexively stimulates the. colon on contact. It usually produces softly formed stools in 6 to 12 hours and is normally taken at bedtime. It is often used as a preparatory agent prior to some surgeries and radiological examinations.

USUAL DOSE.— 10 to 30 mg in one dose for adults. It is available in tablets and suppositories.

Magnesium Citrate (Citrate of Magnesia)

ACTION AND USE.— Magnesium citrate is a saline irritant laxative that also inhibits the absorption of water from the intestine. It is preferred by radiology departments for use prior to special x-rays.

USUAL DOSE.— 200 ml in one dose is the official recommendation. Magnesium citrate is most often provided to the patient in a kit containing 10 fluid ounces of magnesium citrate, 2 tablets of phenophthalein (a contact irritant) and a suppository of either glycerin or bisacodyl.

Psyllium Hydrophilic Mucilloid (Metamucil)

ACTION AND USE.— This is a bulk laxative that works by absorbing water. The effect occurs within 12 to 72 hours. It is provided as a dry powder that is stirred into water or fruit juice. Drink immediately upon mixing while the material is in suspension.

USUAL DOSE.— One rounded teaspoonful stirred or mixed with a glass of cool liquid or juice one to three times daily.

Ducosate Calcium (Surfak)

ACTION AND USE.— Ducosate calcium is a stool softener that promotes water retention in the fecal mass.

USUAL DOSE.— 240 mg daily. For children, give up to 100 mg daily.

Ducosate Sodium (Colace)

ACTION AND USE.— This drug has the same action as ducosate calcium.

USUAL DOSE.— Adult dose ranges from 50 to 240 mg daily.

ANTIDIARRHEALS

Kaolin Mixture with Pectin (Kaopectate)

ACTION AND USE.— Kaolin mixture with pectin is used in the symptomatic treatment of diarrhea. The pectin portion absorbs excess fluid and consolidates the stool. The kaolin portion adsorbs irritants and forms a protective coating on the intestinal mucosa.

USUAL DOSE.— 30 ml after each bowel movement.

Diphenoxylate Hydrochloride (Lomotil)

ACTION AND USE.— Diphenoxylate hydrochloride is used for the symptomatic treatment of diarrhea. It works by direct action on the smooth muscles in the intestine reducing peristalsis and intestinal motility. Because diphenoxylate is a chemical analog of meperidine hydrochloride, it is classed as a schedule V narcotic. To prevent abuse, a sub-therapeutic amount of atropine is added.

USUAL DOSE.— 1 or 2 tablets four times daily until symptomatic control is achieved, then the dose is reduced.

DIURETICS

The kidney is the primary organ that excretes water-soluble substances from the body. Diuretics are agents that increase the rate of urine formation. The term diuresis has two separate connotations: one refers to the net loss of solute and water, the other to the increase in volume *per se.* Sometimes maintenance of an adequate urine volume is justification for using diuretics. The most important indication is for the production of a negative extracellular fluid balance. Diuretics are useful in the treatment of hypertension, edematous conditions, i.e., congestive heart failure, and acute pulmonary edema.

Hydrochlorothiazide (Esidnx, Oretic, Hydrodiuril)

ACTION AND USE.— Hydrochlorothiazide is used for edema associated with congestive heart failure and other edematous conditions. It is also used in the management of hypertension as the sole agent or in combination with other anti-hypertensive agents. It works by inhibiting the reabsorption of sodium and chloride in the renal tubules.

USUAL DOSE.— For edema, give 25 to 200 mg daily. For hypertension, give 25 to 100 mg daily, depending on the patient's response. In many cases, potassium supplements may be indicated.

Chlorthalidone (Hygroton)

ACTION AND USE.— This drug's use is the same as hydrochlorothiazide.

USUAL DOSE.— Given as a single dose with food in the morning. For edema, give 100 mg daily or on alternate days, depending upon the patient. For hypertension, a dosage above 100 mg a day does not normally increase effectiveness. Supplemental potassium should be taken.

Furosemide (Lasix)

ACTION AND USE.— A potent diuretic, furosemide acts on the proximal and distal renal tubules and on the loop of Henle to promote diuresis by inhibiting the reabsorption of sodium and chloride. It is indicated in the treatment of edema associated with congestive heart failure, cirrhosis of the liver, and renal disease. It is particularly useful when greater diuretic potential is desired and may be used in the treatment of hypertension alone or in combination with other anti hypertensive agents.

USUAL DOSE.— Dosage is individualized to the patient's needs and responses. For edema, give 20 to 80 mg as a single dose. For hypertension, initially give 40 mg twice daily, which is adjusted according to response. Other hypertensive agents may be added. As blood pressure falls, reduce the dose. Supplemental potassium should be taken.

Acetazolamide (Diamox)

ACTION AND USE.— Although classified as a diuretic, the primary indication for this drug is the treatment of glaucoma to reduce intraocular pressure.

USUAL DOSE.— 250 mg to 1 g per day, usually in divided doses.

Triamterene and Hydrochlorothiazide (Dyazide)

ACTION AND USE.— This combination of a potassium sparing (Triamterene) and potassium depleting diuretic is often more effective than either drug alone. It has the same indications as hydrochlorothiazide.

USUAL DOSE.— 1 to 2 capsules twice daily after meals. Supplemental potassium is NOT generally indicated.

NON-NARCOTIC ANALGESICS AND ANTIPYRETICS

Analgesics are drugs that relieve pain without producing unconsciousness or impairing mental capacities. Many of these drugs also have an antipyretic and/or an anti-inflammatory effect. Antipyretics are drugs that lower increased body temperatures. Included in this group are the non-steroidal anti-inflammatories.

Aspirin (ASA, Cama, Ascriptin, Ecotrin, Easprin)

ACTION AND USE.— Aspirin is still the most economical analgesic, antipyretic, and anti-inflammatory agent available. Some preparations have an antacid-type buffer to assist in the reduction of gastric irritation. It is an analgesic for mild to moderate pain and an effective antipyretic. Aspirin is also indicated for various inflammatory conditions, such as rheumatoid arthritis, bursitis, etc.

USUAL DOSE.— For analgesic and antipyretic purposes, give 325 to 650 mg every 4 hours as needed. For anti-inflammatory purposes, give up to 5.2 g per day in divided doses with food or milk. NOTE: Aspirin is contraindicated in peptic ulcer disease. It acts as a gastric mucosal irritant and has an anticoagulant effect.

Acetaminophen (Tylenol)

ACTION AND USE.— This drug is similar to aspirin, but it has no anti-inflammatory action. It is available as tablets, elixir, drops, or capsules and is useful in aspirin sensitive patients.

USUAL DOSE.— 300 to 650 mg every 4 hours and up to 1 g four times daily, not to exceed 4 g per day.

Ibuprofen (Motrin)

ACTION AND USE.— Ibuprofen is indicated for the relief of mild to moderate pain, including headaches and menstrual cramps. It is also used as an anti-inflammatory agent in the treatment of arthritis, tendinitis, bursitis, etc. It is not recommended in the third trimester of pregnancy, gastrointestinal bleeding, or renal impairment.

USUAL DOSE.— Do not exceed 2.4 g per day. For mild to moderate pain, give 400 mg every 4 to 6 hours as needed. For anti-inflammatory use, give 300 to 600 mg three or four times daily as needed. It may be taken with food or milk.

Naproxen Sodium (Anaprox)

ACTION AND USE.— Naproxen sodium was developed as an analgesic because it is more rapidly absorbed than naproxen (Naprosyn), a non-steroidal anti-inflammatory with analgesic and antipyretic properties. It is indicated for the relief of mild to moderate pain and for the treatment of primary dysmenorrhea, rheumatoid arthritis, osteoarthritis, tendinitis and bursitis, and acute gout. Its effects are similar to aspirin and indomethacin but with less toxic gastrointestinal side effects; however, it is not indicated for patients with a history of gastrointestinal disease, especially those with a propensity for peptic ulcer disease.

USUAL DOSE.— Two tablets initially then one tablet every 6 to 8 hours as required for mild to moderate pain but not to exceed 5 tablets daily. For long term treatment of arthritis, one tablet twice daily for two to four weeks.

Indomethacin (Indocin)

ACTION AND USE.— Indomethacin is a potent anti-inflammatory agent with antipyretic and analgesic properties. Because it may cause side effects, it should be reserved for cases of chronic rheumatoid arthritis, osteoarthritis, or acute gout.

USUAL DOSE.— 25 to 50 mg two to three times daily not to exceed 200 mg daily.

Tolmetin Sodium (Tolectin)

ACTION AND USE.— Tolmetin sodium has the same indications, contraindications, and uses as indomethacin.

USUAL DOSE.— 400 mg three times daily initially, then adjusted to patient response but not to exceed 2000 mg daily.

Sulindac (Clinoril)

ACTION AND USE.— Sulindac has the same indication, contraindication, and uses as indomethacin and tolmetin sodium but is longer lasting.

USUAL DOSE.— 15o to 200 mg twice daily with food.

Phenylbutazone (Butazolidine)

ACTION AND USE.— Along with its anti-inflammatory properties, phenylbutazone is regarded as a potent analgesic for relief of the pain of rheumatoid arthritis and associated condition. Because of its high incidence of toxic side effects, it is recommended only for patients who do not respond to less toxic drugs. It is also used to relieve the symptoms of acute gouty arthritis when less conservative measures are not effective.

USUAL DOSE.— Initially, 300 to 600 mg daily in three or four equally divided doses with food or milk. The dosage is adjusted to the lowest level to receive favorable results. If favorable results are not obtained in 7 to 10 days, treatment with phenylbutazone should be discontinued.

CENTRAL NERVOUS SYSTEM STIMULANTS

Certain drugs stimulate the activity of various portions of the central nervous system (CNS). Chapter 21 of the *Manual of the Medical Department* (MANMED) is explicit as to the usage of these drugs in the Navy. Primary indications for this class of drugs are narcolepsy, hyperkinesis, and attention deficit disorders in children. Central nervous system stimulants are generally contraindicated in patients with hypertension, arteriosclerosis, symptomatic cardiovascular disorders, agitated states, glaucoma, or history of drug abuse.

Methylphenidate Hydrochloride (Ritalin)

ACTION AND USE.— This drug is indicated for use in hyperkinetic children and children with attention deficit disorders. In children, this drug acts as a central nervous system depressant. It is also indicated for narcolepsy in adults.

USUAL DOSE.— In children, start with small doses, usually 5 mg, and then increase the dosage at a rate of 5 to 10 mg weekly. The doses are given before breakfast and lunch. The average dose for adults is 20 to 30 mg per day, which is given 30 to 45 minutes before meals. Adults with narcolepsy should take the last dose before 6 p.m. NOTE: Methylphenidate hydrochloride therapy should be reevaluated at specific intervals as determined by the physician. Dosage should be individualized to fit the needs of each patient.

Dextroamphetamine Sulfate (Dexedrine)

ACTION AND USE.— Dextroamphetamine is primarily indicated for narcolepsy. Because of its anorectic effect, it is occasionally used to treat exogenous obesity as an adjunct to diet therapy.

USUAL DOSE.— 5 to 60 mg daily in divided doses.

CENTRAL NERVOUS SYSTEM DEPRESSANTS

This large group of drugs ranges in depressive action from mild sedation to deep coma, differing mainly in rapidity, degree, and duration of action. Many of the central nervous system depressants are scheduled medications. Chapter 21 of MANMED describes requirements for control, custody, and accountability of all controlled substances. Any of these agents may, in sufficient doses, cause respiratory depression. Any use of alcohol should be avoided with any of these medications. NOTE: Barbiturates may be habit forming.

The barbiturates are a widely used group of CNS depressants that have the same general action. They are used mainly as sedative-hypnotics, anticonvulsants, anesthetics for short anesthesia, and they may be used in combination with analgesics to potentate their analgesic effect.

Phenobarbital (Luminal)

ACTION AND USE.— Phenobarbital is a long lasting barbiturate frequently used in the treatment of convulsive seizure disorders; this is the drug of choice in petit mal epilepsy. It is also used as a hypnotic or sedative.

USUAL DOSE.— The hypnotic dose is 50 to 100 mg daily; the sedative dose is 15 to 32 mg in divided doses.

Pentobarbital (Nembutal)

ACTION AND USE.— This barbiturate is indicated for short-term treatment of insomnia; it is also used as a preanesthetic medication.

USUAL DOSE.— 100 mg in a single dose.

Secobarbital (Seconal)

ACTION AND USE.— Secobarbital is used the same as pentobarbital and has a rapid hypnotic effect.

USUAL DOSE.— For insomnia, give 100 mg at bedtime. For preoperative medication, give 200 to 300 mg 1 to 2 hours prior to surgery.

Phenytoin Sodium (Dilantin)

ACTION AND USE.— This is a non-barbiturate anticonvulsant used in the treatment of seizure disorders. It is preferred to phenobarbital because it has no hypnotic properties. It is frequently used in combination with phenobarbital for more effective management of certain epilepsies. Phenytoin sodium is the drug of choice in the treatment and management of grand mal epilepsy.

USUAL DOSE.— 300 to 400 mg daily in 2 or 3 divided doses. It may be taken with food or milk. Dosage should be individualized to provide maximum benefit.

Alcohol (Ethyl Alcohol, Ethanol)

ACTION AND USE.— In small doses alcohol stimulates the gastric mucosa, increasing the flow of juices. Systemically, it is a sedative. Continual small doses produce hypnotic effects. Its main use in Navy medicine today is in compounding various preparations not usually stocked by the pharmacy.

OPIUM AND IT ALKALOIDS

The most important alkaloids of opium are morphine and codeine. All of the other opiate

derivatives are severe respiratory depressants. Small doses dull the cough reflex and larger doses abolish it. These drugs may cause constipation by diminishing the secretions of the gastrointestinal tract and increasing the tone of the intestinal muscles to the point of spasm. Members of this class are used as analgesics, cough sedatives, and for certain types of diarrhea.

Paregoric (Camphorated Opium Tincture)

ACTION AND USE.— Paregoric is mainly used as an intestinal tranquilizer to control diarrhea.

USUAL DOSE.— 5 to 10 ml one to four times daily.

Morphine Sulfate

ACTION AND USE.— This drug is indicated for the relief of severe pain and is used preoperatively to sedate patients. It is also used in the treatment of severe pain associated with myocardial infarction. It is contraindicated in patients with head injuries, acute alcoholism, and convulsive disorders.

Codeine Sulfate

ACTION AND USE.— Codeine sulfate is like morphine, but has one-sixth of the analgesic power and one-fourth of the respiratory depressant effect of morphine. It is used for moderate to severe pain and as an antitussive.

USUAL DOSE.— As an analgesic, give 15 to 60 mg every 4 hours, regardless of route. As an antitussive, give 10 to 20 mg every 4 to 6 hours. DO NOT EXCEED 120 MG IN 24 HOURS.

Meperidine Hydrochloride (Demerol)

ACTION AND USE.— This is a synthetic analgesic similar to morphine. It is used for moderate to severe pain and as a preoperative medication. It is not as effective as morphine in its analgesic properties.

USUAL DOSE.— As an analgesic, adjust dosage according to the severity of pain and the response of the patient. Give 50 to 150 mg intramuscularly, subcutaneously, or orally every 3 to 4 hours as necessary.

PSYCHOTHERAPEUTIC AGENTS

Tranquilizers and mood modifiers are the two primary groups of psychotherapeutic agents. They are classified as major tranquilizers, minor tranquilizers, and mood modifiers. The mood modifiers have replaced the amphetamines as treatment of choice for depressive states.

Chlorpromazine Hydrochloride (Thorazine)

ACTION AND USE.— This drug is indicated for alleviating manifestations of psychosis, tension, and agitation. Dosage is highly individualized depending on the severity of symptoms and degree of response. It may also be used as an antiemetic.

USUAL DOSE.— As an antiemetic, give up to 0.5 mg per pound every 4 to 6 hours as needed. As an antipsychotic, dosage is individualized as described above and may range from 10 mg to 1 g daily, usually given in three divided doses.

Thioridazine (Mellaril)

ACTION AND USE.— Thioridazine is used for antipsychotic purposes and is considered to be a good all-around tranquilizer.

USUAL DOSE.— Starting dose is 50 to 100 mg three times daily with gradual incremental increases to a maximum of 800 mg per day, if necessary.

Prochlorperizine (Compazine)

ACTION AND USE.— This drug is most often used in the symptomatic treatment of nausea and vomiting but shares all the antipsychotic effects of chlorpromazine.

USUAL DOSE.— Orally, give 5 to 20 mg three or four times daily. Rectally, give 25 mg twice daily. Intramuscular dosage should not exceed 40 mg daily. It is available as tablets, capsules, syrups, injections, and suppositories.

Haloperidol (Haldol)

ACTION AND USE.— Haloperidol is indicated in the treatment of schizophrenia with manifestations of acute manic symptoms, social withdrawal, and paranoid behavior, and the manic stage of manic-depressive patients.

USUAL DOSE.— As with chlorpromazine, dosages are highly individualized and may range from 0.5 mg to 8 mg or higher on a daily basis.

Lithium (Eskalith, Lithane)

ACTION AND USE.— Lithium is used in the treatment of manic episodes of manic-depressive illness. It is the drug of choice to prevent or diminish the intensity of manic episodes.

USUAL DOSE.— Dosage must be individualized according to serum levels and clinical response. Give 600 mg three times daily or 900 mg twice daily for the slow release form.

Amitriptyline Hydrochloride (Elavil)

ACTION AND USE.— Amitriptyline is an antidepressive mood elevator with mild tranquilizing effects. It is indicated for the long-term treatment of depressive disorders.

USUAL DOSE.— Initially, 75 mg daily in three divided doses but may be increased to 150 mg daily dependant on clinical response.

Chlordiazepoxide Hydrochloride (Librium)

ACTION AND USE.— Chlordiazepoxide hydrochloride is an antianxiety agent indicated for the treatment of anxiety disorders. It is not indicated for anxiety or tension associated with the stress of everyday activities. It is also indicated in the abatement of acute withdrawal symptoms of alcoholism.

USUAL DOSE.— Optimum dose is dependant upon the patient's condition and clinical response. It may range from 5 mg 3 or 4 times daily to 25 mg 3 or 4 times daily.

Hydroxizine Hydrochloride (Vistaril)

ACTION AND USE.— Hydroxizine Hydrochloride is a rapid acting anti-anxiety and antiemetic with antispasmodic and muscle relaxant effects. It is most often used in pre- and postoperative sedation and in conjunction with meperidine hydrochloride to potentate its effects and reduce nausea. It is for intramuscular or oral use only, not for intravenous use.

USUAL DOSE.— 50 mg is the normal dose with ranges from 25 to 100 mg.

Diazepam (Valium)

ACTION AND USE. —Diazepam is useful in treating mild to moderate depression with anxiety and tension. Because of its muscle relaxant properties, it is also used to treat spastic muscle conditions and convulsive seizure episodes; it is the drug of choice in status epileptics. Diazepam is probably one of the most abused of the prescription drugs and has both psychological and physical dependence properties. Withdrawal symptoms may manifest with sudden cessation after long-term use.

USUAL DOSE.— Dosages may range from 2 to 40 mg daily in 2 to 4 equally divided doses.

Flurazepam (Dalmane)

ACTION AND USE.— Flurazepam is a hypnotic indicated for the treatment of insomnia.

USUAL DOSE.— 15 to 30 mg at bedtime.

SKELETAL MUSCLE RELAXANTS

These agents may be used to produce muscular relaxation during surgical anesthesia. More often these drugs are used in connection with the treatment of muscle spasm due to various conditions. All of these drugs may cause drowsiness and impair performance of tasks that require alertness.

Methocarbamol (Robaxin)

ACTION AND USE.— Methocarbamol is used as an adjunct to rest, physical therapy, and other measures for the relief of discomfort associated with acute, painful musculoskeletal conditions.

USUAL DOSE.— 1 g four times daily, or 1.5 g two or three times daily.

Cyclobenzaprine Hydrochloride (Flexeril)

ACTION AND USE.— Cyclobcnzaprine hydrochloride is indicated for short term treatment of skeletal muscle spasms of local origin.

USUAL DOSE.— 10 mg three times daily for up to three weeks.

Chlorzoxazone and Acetaminophen (Parafon Forte)

ACTION AND USE.— This drug combination is used the same as methocarbamol. This agent combines an analgesic with a muscle relaxant.

USUAL DOSE.— 2 tablets four times daily.

Orphenadrine, Aspirin, and Caffeine (Norgesic)

ACTION AND USE.— This combination is also used the same as methocarbamol. This drug has an analgesic-anti-inflammatory agent (aspirin) and a CNS stimulant included in its formulation.

USUAL DOSE.— 1 to 2 tablets three or four times daily.

CARDIOVASCULAR AGENTS

Cardiovascular drugs comprise a large group that affect the action of the circulatory system. Most of these agents are highly specialized and will be listed according to their principal action.

Digitoxin (Crystodigin, Purodigin)

ACTION AND USE.— Digitoxin has a direct effect on the myocardium, causing an increase in the force of contraction. It is indicated for all degrees of congestive heart failure and for various arrhythmias.

USUAL DOSE.— The average digitalizing dose is given intravenously (1.2 to 1.6 mg). Maintenance dosage range is from 0.05 to 0.3 mg daily.

Digoxin (Lanoxin)

ACTION AND USE.— This drug is used the same as digitoxin.

USUAL DOSE.— Digitalization is individualized for each patient for optimum response. The maintenance dosage range is from 0.125 to 0.5 mg daily, It is available as tablets, pediatric elixir, capsules, and injections.

Quinidine Sulfate

ACTION AND USE.— Quinidine sulfate is indicated for premature atrial and ventricular contractions and other arrhythmias.

USUAL DOSE.— Normal range is 200 to 600 mg three or four times daily. **NOTE: DO NOT CONFUSE WITH QUININE SULFATE, AN ANTIMALARIAL.**

VASODILATORS

These drugs produce vasodilation by relaxing the smooth muscle of the arteries, thereby lowering the blood pressure. This fall in blood pressure is the most important pharmacological action desired.

Amyl Nitrite

Amyl nitrite is used occasionally for cardiac patients. This drug is primarily used for the prevention of erection in urological adult male patients following circumcision.

Nitroglycerin (Nitrostat, Nitro-Bid)

ACTION AND USE.— Nitroglycerin is indicated for the treatment and management of acute and chronic angina pectoris.

USUAL DOSE.— It is available as sublingual tablets, buccal tablets, sustained-release tablets and capsules, topical ointment, and topical patches. Nitroglycerin is also available in the injection form. Sublingual tablets are to be kept in the original container, tightly closed. Usual dose for the sublingual tablets is 1 tablet sublingually every 5 minutes up to 3 tablets in a 15 minute period during an angina attack. If there is no relief at that time, the patient should contact a physician. Other nitroglycerin dosages are individualized to meet the patient's needs.

Isosorbide Dinitrate (Isordil, Sorbitrate)

ACTION AND USE.— This drug is similar to nitroglycerin in its antianginal action.

USUAL DOSE.— 2.5 to 10 mg, up to 30 mg every 4 to 6 hours sublingually as a prophylaxis. It is available as sublingual tablets, chewable tablets, oral tablets, and sustained-release tablets and capsules.

Pyridamole (Persantine)

ACTION AND USE.— Pyridamole is possibly effective for long-term therapy of chronic angina pectoris. It is not intended to abort the acute anginal attack.

USUAL DOSE.— 50 mg three times daily taken at least 1 hour before meals with a full glass of liquid.

Procainamide Hydrochloride (Pronestyl, Procan SR)

ACTION AND USE.— This drug is indicated for the treatment of various arrhythmias.

USUAL DOSE.— Oral administration is preferred to the parenteral route. Dosage is individualized to meet the patient's needs and responses. It is available as tablets, capsules, sustained-release tables, and injections.

VASOCONSTRICTORS

The opposite of vasodilators, these drugs produce constriction of the blood vessels with consequent rise in blood pressure.

Epinephrine (Adrenalin, Sus-Phrine)

ACTION AND USE.— Most prominent actions are on the heart, producing a rapid rise in blood pressure, increased strength of ventricular contraction, increase in the heart rate, and constriction of the arterioles in the skin and mucosa. It also relaxes the smooth muscles of the bronchi, and produces an increase in blood sugar and glycogenolysis in the liver. It is the drug of choice in anaphylaxis.

USUAL DOSE.— T0 treat cardiac arrest, administer intravenously as an adjunct to external cardiac compression at 0.5 to 1 mg every 5 minutes. For anaphylaxis, give 0.3 to 0.6 mg subcutaneously; intramuscular injection should be avoided since the action of epinephrine may cause necrosis of the muscular tissue. Sus-Phrine is a suspension for subcutaneous use only; it is for the temporary relief from bronchial asthma attacks.

Tetrahydrozaline Hydrochloride (Visine)

ACTION AND USE.— This is an ophthalmic preparation for the symptomatic relief of irritated eyes.

USUAL DOSE.— 2 to 3 drops every 3 to 4 hours.

Phenylephrine Hydrochloride (Neo-Synephrine)

ACTION AND USE.— Phenylephrine hydrochloride is used to shrink mucous membranes of the nose and to relieve local congestion.

USUAL DOSE.— A 0.25 percent solution, instill 1 to 3 drops into each nostril four times daily as needed.

Oxymetazoline Hydrochloride (Afrin)

ACTION AND USE.— A topical vasoconstrictor, it is used to relieve nasal congestion.

USUAL DOSE.— A 0.05 percent solution, spray the affected nostril twice daily. **DO NOT USE FOR LONGER THAN 3 DAYS.**

HEMOSTATIC

These are drugs that control external bleeding by forming a clot.

Absorbable Gelatin Sponge

ACTION AND USE.— This is a sterile, water-insoluble, gelatin base sponge. It is used as a hemostatic agent when saturated with a sterile normal saline solution or a thrombin solution. It may be left in the body since it is slowly absorbed.

ANTICOAGULANTS

These drugs delay or prevent blood coagulation. Use of these agents requires laboratory facilities to determine prothrombin time and partial thromboplastin time values to determine dosages.

Heparin Sodium

ACTION AND USE.— Heparin sodium inhibits the clotting of blood and the formation of fibrin clots. It is used in anticoagulant therapy in prophylaxis of venous thrombosis and as a treatment to prevent its extension, as well as in the prophylaxis and treatment of pulmonary embolism.

USUAL DOSE.— As prescribed by a physician.

Warfarin Sodium (Coumadin)

ACTION AND USE.— This drug interferes with prothrombin formation in the liver. It is used

extensively in the treatment of embolism and in the prevention of occlusions.

USUAL DOSE.— As prescribed by a physician.

VITAMINS

Vitamins are essential substances for maintenance of normal metabolic functions. They are not synthesized in the human body in normally adequate quantities; therefore, they must be provided from outside sources.

Vitamin A (Retinol)

Vitamin A is a fat-soluble vitamin necessary for visual adaptation to darkness. Deficiencies rarely occur in well nourished individuals and an excess of vitamin A can be toxic. Retinoic acid, a degradation product of retinol, is useful as a keratolytic in the treatment of acne and pseudofolliculitis barbae.

Thiamine Hydrochloride (Vitamin B_1)

Thiamine hydrochloride is necessary for carbohydrate metabolism. This vitamin is used in the treatment of patients with appetite loss resulting from dietary disturbances. The deficiency disease is beriberi.

Riboflavin (Vitamin B_2)

Riboflavin functions in the body as a coenzyme necessary in tissue respiratory processes, e.g., oxidation reduction reactions. Deficiency is associated with cheilosis, glossitis, or visual disturbances or visual fatigue. It is most commonly used with nicotinic acid (niacin) in the treatment of pellagra.

Pyridoxine Hydrochloride (Vitamin B_6)

Pyridoxine hydrochloride is a coenzyme in the metabolism of protein, carbohydrate, and fat. It is most often used during isoniazid (INH) therapy to prevent the development of peripheral neuritis.

Cyanocobalamin (Vitamin B_{12})

Cyanocobalamin is essential to growth, cell reproduction, and hematopoiesis. Vitamin B_{12} is used in the treatment of pernicious anemia and treatment is continued indefinitely. Folic acid is normally given as a supplemental therapy.

NOTE: ALL OF THE B VITAMINS ARE WATER-SOLUBLE.

Ascorbic Acid (Vitamin C)

Ascorbic acid is a water-soluble vitamin necessary for the prevention and cure of scurvy. It is also believed that a deficiency in vitamin C delays wound healing.

Vitamin D

Vitamin D, a fat-soluble vitamin, is involved in the regulation of calcium and phosphorus metabolism. Vitamin D deficiency leads to rickets in children and osteomalacia in adults.

Vitamin K

The naturally occurring form is a fat-soluble vitamin while many of the synthetic forms are water-soluble. Vitamin K is involved in the formation of prothrombin and other blood clotting factors. Deficiency results in an increase in blood-clotting time.

ANESTHETICS

Generally speaking, anesthesia means "without feeling"; consequently, we apply the word to drugs that produce insensibility to pain. The field today is a highly specialized one.

General Anesthesia and Anesthesia Induction Agents

Since general anesthetics are usually gas or vapor and are administered by inhalation, administering them remains a highly specialized field and should never be undertaken by a hospital corpsman without the supervision of a medical officer. There may be times when you, as a hospital corpsman, will be called upon to administer general anesthesia; therefore, it will behoove you to understand its principles.

Nitrous Oxide (Laughing Gas)

ACTION AND USE.— It is usually used with an adequate amount of oxygen in general anesthesia. Nitrous oxide may produce a condition during which the patient may laugh and become quite talkative. It is commonly used in dentistry or as a preinduction agent to other general anesthetics.

CAUTION: High concentrations of nitrous oxide may cause cyanosis and asphyxia.

Halothane (Fluothane)

ACTION AND USE.— Halothane can be used for inhalation anesthesia in every known operative procedure in patients of all ages. Use of halothane permits high oxygen concentration and use of cautery. Virtually nontoxic, recovery is rapid and remarkably free of excitement, nausea, and vomiting. It is nonflammable and nonexplosive. It is contraindicated in obstetrics or in patients with hepatic dysfunction.

Ketamine Hydrochloride (Ketalar)

ACTION AND USE.— Ketamine hydrochloride is a rapid general anesthetic agent for procedures that do not require skeletal muscle relaxation or as a preinduction agent. One significant side effect of this agent is when the patient begins to recover from the drug he or she may experience psychological manifestations ranging from pleasant dream-like states to hallucinations to delirium accompanied by confusion or irrational behavior. The effects of these manifestations may be minimized by keeping aural and tactile stimuli to a minimum. It is contraindicated in patients with hypertensive disease.

USUAL DOSE.— No usual dose has been determined; ketamine hydrochloride must be titrated to individual patient response.

Fentanyl and Droperidol (Innovar)

ACTION AND USE.— This is a combination of a narcotic (fentanyl) and a tranquilizer (droperidol). Because of the selfpotentiating combination, it must be used with extreme caution in patients with any respiratory problems.

Local Anesthetics

These drugs produce loss of sensation to pain in a specific area or locality of the body, without loss of consciousness or mental capacity. The majority of these drugs are administered parenterally or topically.

Procaine Hydrochloride (Novocain)

ACTION AND USE.— Administered only by injection, it may be used for most types of local anesthesia including spinal anesthesia. It is available in various solutions for injection.

Lidocaine Hydrochloride (Xylocaine)

ACTION AND USE.— This is the standard to which all other local anesthetics are compared. It may be combined with epinephrine for vasoconstrictive effects and is used for all types of local anesthesia. Lidocaine is also used in the treatment of myocardial infarctions to prevent or suppress preventricular contractions. CAUTION: Total dosage injected in 24 hours should not exceed 0.05 g per patient when used with epinephrine. It is available as an ointment, jelly, solution for injection, solution for gargle, and spray.

Dibucaine Hydrochloride (Nupercaine)

ACTION AND USE.— Dibucaine hydrochloride is used as a topical anesthetic on mucous membranes and is also administered parenterally. It is available as an ointment for topical use or as a solution for injection.

Proparacaine (Ophthetic, Ophthaine)

ACTION AND USE.— This is a topical ophthalmic anesthetic suited for almost every ophthalmic procedure. It is fairly long lasting.

AUTONOMIC DRUGS

The autonomic nervous system, also called the visceral or involuntary nervous system, controls the autonomic functions of the body. Drugs that affect the autonomic nervous system are highly specialized and therefore are classified according to their effect.

Parasympathetic Drugs

These drugs, also called cholinomimetics, stimulate the structures controlled by the parasympathetic nerves. They are either direct acting or indirect acting.

Neostigmine Methylsulfate (Prostigmin)

ACTION AND USE.— Neostigmine methylsulfate is indicated for the symptomatic control of myasthenia gravis.

USUAL DOSE.— The greatest use is in the oral form in prolonged therapy when no difficulty in swallowing is present. It varies from 15 to as much as 375 mg per day. The average dosage is 150 mg given over 24 hours.

Bethanechol Chloride (Urecholine, Duvoid)

ACTION AND USE.— This drug is used for acute postoperative and postpartum nonobstructive urinary retention and neurogenic atony of the urinary bladder with retention.

USUAL DOSE.— Orally, give 10 to 50 mg two to four times daily; maximum dose is 120 mg. Parenterally, SUBCUTANEOUSLY ONLY, give 5 mg.

Pilocarpine (Pilocar, Isopto-Carpine)

ACTION AND USE.— Pilocarpine decreases intraocular pressure in glaucoma.

USUAL DOSE.— Initially, instill 1 drop into the eye, up to six times daily. The average dose is 1 drop two to four times daily.

Parasympatholytic Drugs (Anticholinergic Drugs)

These drugs oppose the effect of impulses conveyed by the parasympathetic nerves. They act as competitive inhibitors of acetylcholine; they relax smooth muscles and inhibit secretions of duct glands.

Atropine Sulfate (Alkaloid obtained from Belladonna)

ACTION AND USE.— There are two major actions: (1) On the central nervous system, it causes an increase in respiration; and (2) on the smooth muscles and secretory glands, it relaxes the muscles of the intestinal tract, bronchi, ureter, biliary ducts, and gallbladder. It inhibits glandular secretions, causing dryness of the nose, throat, bronchi, mouth, and skin.

Atropine has a mydriatic effect on the pupil of the eye and causes a paralysis of accommodation. Atropine is used as a mydriatic and cycloplegic in ophthalmology, as an anhydrotic (checking the secretion of sweat), in large doses as a circulatory stimulant, and as a respiratory stimulant in certain poisonings. It is a physiologic antidote for neostigmine, pilocarpine, nerve gases, and other parasympathomimetics. Atropine may be given with morphine to overcome the respiratory depressant effects of morphine. It is used preoperatively to reduce salivary and bronchiole secretions.

USUAL DOSE.— For ophthalmic purposes, instill 1 or 2 drops into the eye(s) up to three times daily or 1 hour prior to examination. Orally and parenterally for other indications, give 0.4 to 0.6 mg as directed by a physician.

Propantheline Bromide (Pro-Banthine)

ACTION AND USE.— This drug is used as adjunctive therapy in the treatment of peptic ulcer by reducing the volume and the acidity of gastric secretions. It is also used as an antispasmodic in the treatment of intestinal spasms and in spasms of the ureter and bladder.

USUAL DOSE.— 15 mg taken 30 minutes before meals and 30 mg at bedtime.

Glycopyrrolate (Robinul)

ACTION AND USE.— Glycopyrrolate is also used as adjunctive therapy in the treatment of peptic ulcer. It is also indicated for intramuscular or intravenous use in conjunction with anesthesia.

USUAL DOSE.— Orally, give 1 mg three times daily or 2 mg two or three times daily. Parenterally, give 0.002 mg/pound intramuscularly 30 minutes to 1 hour prior to anesthesia.

Sympathomimetic Drugs

These drugs stimulate the structures controlled by the sympathetic (or adrenergic) nerves and start adrenal medullary discharge of epinephrine. The two main drugs, epinephrine and phenylephrine are discussed under the vasoconstrictive drugs earlier in this chapter.

Sympatholytic Drugs

Also called adrenergic blocking agents, these drugs block the action of the sympathomimetic amines or block sympathetic outflow. The alpha-adrenergic blocking agents block the vasoconstricting effects of epinephrine and norepinephrine, thereby lowering the blood pressure. The beta-adrenergic blocking agents block the cardiac

and vasodilating effects of epinephrine and the cardiac effects of norepinephrine, thereby lowering the force of cardiac contractions and decreasing the heart rate.

Propranolol Hydrochloride (Inderal)

ACTION AND USE.— Propranolol hydrochloride is a beta-blocker with many uses. It is indicated for essential hypertension, prophylaxis of angina pectoris, cardiac arrhythmias, and prophylaxis of common migraine headaches.

USUAL DOSE.— It varies with each indication and is individualized to meet each patient's needs. Do not discontinue medication abruptly without consulting the physician. It is available as regular tablets, sustained-release capsules, and in the injection form.

Essential Hypertension.— 160 to 480 mg per day, up to 640 mg daily in divided doses.

Angina Pectoris.— 160 mg per day.

Cardiac Arrhythmias.— 10 to 30 mg three or four times daily, before meals and at bedtime.

Migraine.— 160 to 240 mg per day in divided doses.

NOTE: There are many beta-blockers not discussed here. Included in this group are Metaprolol, Atenolol, Nadolol, and Timolol. Their indications and effects are similar to propranolol hydrochloride.

Methyldopa (Aldomet)

ACTION AND USE.— Methyldopa is indicated for the treatment of essential hypertension.

USUAL DOSE.— 500 mg to 2 g given in two to four doses. The maximum daily dose is 3 g.

Reserpine (Sandril, Serpisil)

ACTION AND USE.— This drug is also indicated for the treatment of essential hypertension.

USUAL DOSE.— 0.1 to 0.25 mg per day.

Hydralazine Hydrochloride (Apresoline)

ACTION AND USE.— Hydralazine hydrochloride is used in the treatment of essential hypertension, usually in combination with other agents.

USUAL DOSE.— Take 50 mg four times daily with meals, up to 400 mg per day.

OXYTOCICS

These are drugs that produce a rhythmic contraction of the uterus. Their action is selective for the uterus, although other smooth muscles are affected.

Ergonovine Maleate (Ergotrate)

ACTION AND USE.— This drug is used in the prevention and treatment of postpartum and postabortal hemorrhage.

USUAL DOSE.— It is intended primarily for routine intramuscular injection of 0.2 mg. Orally, 1 to 2 tablets may be given every 6 to 12 hours.

Oxytocin (Pitocin)

ACTION AND USE.— Oxytocin is indicated for the initiation or improvement of uterine contractions or to control postpartum hemorrhage.

USUAL DOSE.— By intravenous infusion, use the drip method. No more than 1 to 2 ml/minute. Gradually increase until the contraction pattern has been established.

ANTIHISTAMINES

Histamine is a substance found in tissue that has an important role in allergic reactions. This has led to the development of compounds that op pose its action. These drugs apparently compete with histamine at the site of action. The drugs listed here are representative of the entire group many of which are used for the symptomatic relief of seasonal rhinitis. Any of these drugs may cause drowsiness.

Diphenhydramine Hydrochloride (Benadryl)

ACTION AND USE.— Diphenhydramine hydrochloride is indicated for the symptomatic

treatment of uticaria, allergic rhinitis, serum reactions, and other allergic conditions.

USUAL DOSE.— 25 mg up to four times daily.

Chlorpheniramine Maleate (Chlor-Trimeton)

ACTION AND USE.— This drug is used for the symptomatic treatment of urticaria and other allergic conditions.

USUAL DOSE.— 4 mg up to four times daily.

Meclizine Hydrochloride (Antivet, Bonine)

ACTION AND USE.— Meclizine hydrochloride has a longer duration of action than diphenhydramine hydrochloride. It is used for the relief of motion sickness and is contraindicated in pregnancy.

USUAL DOSE.— 25 mg once daily, first dose taken 1 hour prior to start of trip.

Dimenhydrinate (Dramamine)

ACTION AND USE.— Similar to other antihistamines, the greatest usefulness of this drug is the prevention and treatment of motion sickness. It may also be used to control nausea and vomiting in connection with radiation sickness.

USUAL DOSE.— 50 mg four times daily.

HISTAMINE H, RECEPTOR ANTAGONISTS

Cimetidine (Tagamet)

ACTION AND USE.— Cimetidine inhibits histamine at the gastric receptor sites. It is used to promote healing of duodenal ulcers.

USUAL DOSE.— 150 mg twice daily. Antacids given concomitantly do not interfere with absorption.

Ranitidine (Zantac)

ACTION AND USE.— Like Cimetidine, it inhibits histamine at the gastric receptor sites and is used to promote healing of duodenal ulcers. Antacids given concomitantly do not interfere with absorption.

USUAL DOSE.— 150 mg twice daily. Some patients may have to have their dosage adjusted based on clinical response.

COLD RELIEF PREPARATIONS

Pseudoephedrine Hydrochloride (Sudafed)

ACTION AND USE.— Pseudoephedrine hydrochloride is indicated for the symptomatic relief of nasal congestion due to the common cold, hay fever, or other upper respiratory allergies.

USUAL DOSE.— 60 mg every 6 hours. Do not exceed 240 mg in 24 hours.

Pseudoephedrine Hydrochloride and Triprolidine Hydrochloride (Actifed)

ACTION AND USE.— This antihistamine and decongestant combination is indicated for the symptomatic relief of colds, hay fever, etc.

USUAL DOSE.— 1 tablet three times daily.

Phenylpropanolamine and Guaifenesin (Entex-LA)

ACTION AND USE.— This drug combination is used the same as pseudoephedrine hydrochloride.

USUAL DOSE.— One tablet three times daily.

Phenylephrine Hydrochloride, Phenylpropanolamine Hydrochloride, and Brompheniramine Hydrochloride (Dimetapp Extentabs)

ACTION AND USE.— This drug is indicated for the temporary relief of cold symptoms or those from hay fever.

USUAL DOSE.— One tablet every 12 hours.

Pseudoephedrine Hydrochloride and Dexbrompheniramine Hydrochloride (Drixoral)

ACTION AND USE.— This drug combination is used the same as Dimetapp.

USUAL DOSE.— One tablet every 12 hours.

BIOLOGICAL AGENTS

Biological are agents that are prepared from living organisms or their products. The chief purpose served by these preparations in the Navy is the immunization of personnel against infectious disease. They may, however, be used in the treatment of disease or act in a diagnostic capacity. Dosage and routes of administration are described in BUMEDINST 6320.1 series.

Biological include serums, viruses, toxins, antitoxins, antigens, and bacterial vaccines.

Manufacturers of these products must be licensed by the Secretary of the Treasury. Their products are monitored by the U.S. Public Health Service.

The label that must be placed on each package will bear the name, address, and license number of the manufacturer. It will also list the name of the product, lot number, date of manufacture, or expiration, period of potency, and the minimum potency or the fact that there is no standard of potency.

IMMUNIZING AGENTS

Diphtheria Antitoxin

Diphtheria antitoxin is a transparent or slightly opalescent liquid, nearly colorless, and has a very slight odor due to its preservative. It is a sterile solution of antitoxic substances obtained from the blood serum or plasma of a healthy horse immunized against diphtheria toxin.

Tetanus Antitoxin

Tetanus antitoxin is a sterile solution of antitoxic substances that are usually obtained from the blood serum or plasma of a healthy horse which has been immunized against tetanus toxin or toxoid. It contains not more than 0.4 percent cresol or 0.5 percent phenol as a preservative. It is slightly opalescent with a yellow, brown, or greenish color, depending upon the manufacturer. There will be a slight odor of the preservative used.

Tetanus Toxoid

Tetanus toxoid is a sterile solution of the growth of the tetanus bacillus, *Clostridium tetani,* which has been treated with formaldehyde. It is a brownish yellow or slightly turbid liquid, usually having the distinctive odor of formaldehyde.

Alum Precipitated Diphtheria and Tetanus Toxoids and Pertussis Vaccines Combined

This is a markedly turbid, whitish liquid. It is nearly odorless or may have a slight odor of the preservative. It is a sterile suspension of the precipitate obtained by treating the mixture of diphtheria toxoid, tetanus toxoid, and pertussis vaccine with alum and combining in such proportions as to ensure an immunizing dose of each in the total dosage as listed on the label.

Cholera Vaccine

Cholera vaccine is a suspension of killed cholera, *Vibrio comma,* in a suitable diluent, usually normal saline. The vaccine presents a turbid appearance, and there may be a slight odor due to the preservative. On storage, autolysis may occur so that the vaccine may become almost as clear as water.

Poliovirus Vaccine Live, Oral Trivalent (Sabin)

This vaccine is indicated for the prevention of poliomyelitis caused by types 1, 2, and 3 polioviruses. **UNDER NO CIRCUMSTANCES SHOULD THIS VACCINE BE ADMINISTERED PARENTERALLY.** To maintain potency, it is necessary to store the vaccine in the freezer compartment of the refrigerator. It should be noted that certain forms of this vaccine will remain fluid at temperatures above minus 14 degrees Centigrade. If frozen, after thawing, agitate the vaccine to ensure homogeneity of its contents prior to use. Once the temperature rises above 0°C, the vaccine MUST BE USED WITHIN SEVEN DAYS. During this period, it must be stored below 10°C.

Yellow Fever Vaccine

This vaccine is a dull, light-orange, flaky or crust-like desiccated mass that requires dehydration immediately prior to use. It must be stored at or below 0°C until dehydration is effected with sterile sodium chloride injection USP.

Plague Vaccine

This is a sterile suspension of killed plague bacilli in an isotonic solution. The strain of bacilli used has been selected for its high antigenic

efficiency. The vaccine is a turbid, whitish liquid with little or no odor. The presence of any precipitate is reason to suspect contamination.

Influenza Virus Vaccine

The influenza virus vaccine is prepared from the allantoic fluid of incubated fertile hen eggs. It is a slightly hazy fluid, which is the result of slight amounts of egg protein. Its color varies from gray to very faint red, depending upon the method of manufacture.

The duration of immunity is probably no longer than a few months, which necessitates repeating the inoculation prior to the expected seasonal occurrence.

Do not inoculate individuals who are known to be sensitive to eggs or egg products, or personnel suffering from upper respiratory infections.

Dried Smallpox Vaccine

This vaccine is prepared directly from calf lymph, purified, concentrated, stabilized, and dried by lyophilization. Dried smallpox vaccine is much more stable than the conventional liquid. When stored at or below 25°C, it retains its full potency for 18 months. When reconstituted, it retains its full potency for 3 months if kept below 4°C (preferable 0°C).

FACTORS TO BE REMEMBERED IN CONNECTION WITH BIOLOGICAL

1. Acquisition. Most immunizing agents that are used in routine procedures may be obtained through normal supply channels. Yellow fever vaccine must be ordered from activities that have been designated as supply points for this biological.
2. Storage. Biological will be stored in a cool, dry, and preferably dark place. Yellow fever vaccine must be maintained in a frozen state until prepared for use.
3. Examination. All biological products should be examined periodically, and a minute examination for deterioration will be held immediately preceding their use.

EXAMINATIONS OF PARENTERAL SOLUTIONS

Solutions will have been examined at least three times at the activity at which they are ultimately used:

1. Upon receiving the solution.
2. Periodically while in storage.
3. Immediately preceding use. Parenteral solutions, unless the label states otherwise, must be free of turbidity or undissolved material. All solutions should be inverted and gently swirled in order to bring any sediment or particulate matter into view. A well-illuminated black or white background will facilitate this examination.

Parenteral solutions may be unfit for use because of:

1. Deterioration from prolonged storage.
2. Accidental contamination occurring upon original packaging.
3. Defects that may develop in containers or seals.

There is no set rule that can be applicable in regards to any of these factors. Therefore, to ensure suitability for use, a regimented program of inspection is necessary.

TOXICOLOGY

Toxicology is the science of poisons. It is concerned with the detection, isolation, and quantitative estimation of poisons, their chemical and physiologic effect on the ordinarily healthy organism, and the antidotes for their toxic effects.

A poison is a substance that may produce death, serious illness, or harmful effects when introduced into the body in a relatively small quantity.

The effects of poisons maybe local or remote and some poisons have both effects. LOCAL EFFECT means direct action on the part to which the poison is applied, such as corrosion and irritation. REMOTE EFFECT means the action of the poison on some organ remote from the site of application or point of introduction. Sometimes, a poison shows no effect or only a slight one, until several doses have been taken. Then suddenly, an effect is produced that nearly equals that produced by taking the whole amount at one time. This is known as CUMULATIVE EFFECT.

The effect of a poison depends upon its volubility, the method of its introduction into the body, and the rapidity of its absorption into the system. The method of introduction may determine its toxicity. For example, snake venom taken into the mouth and perhaps even into the stomach

during first aid treatment of snakebite is not ordinarily harmful, but snake venom injected parenterally is extremely poisonous.

There are various ways in which poisons may be introduced into the body, the most common being by mouth, inhalation, and injection. Poisons taken by mouth enter the circulation through absorption from the stomach and intestine. Those inhaled enter the circulation through the lungs. When parenterally injected or deposited into the urethra, rectum, or vagina, poisons enter the circulation through absorption from the body tissues in those areas. If the injection is intravenous, the poisons are directly introduced into the bloodstream. Poisons may also be introduced by application to open wounds and to the unbroken skin. After entering the circulation, a poison is carried by the blood to the tissues and organs susceptible to its action and attacks them.

Most of the excretion of poisons from the body occurs in the kidneys, liver, gastrointestinal tract, and skin. Poisons may be excreted from the system unchanged or in the form of other compounds into which they have been transformed by the action of various body organs and tissues. The most damaging effects of some poisons are found at the point of excretion.

Various conditions of the individual may modify the actions and effects of poisons on the body. The age of the victim makes a great deal of difference, with young children being more susceptible to poisons than adults. Conditions caused by poisons will vary because of a personal idiosyncrasy; that is to say, some persons by nature are unusually sensitive to certain poisons, while others possess a natural tolerance for certain poisons that is not the result of habitual use. Through habitual use of certain poisons, especially narcotics, most persons may become so accustomed to their effects that they are not poisoned when taking doses that would ordinarily prove lethal in the unaddicted. It occasionally happens, however, that continual external use of chemical substances results in hypersensitivity. The actions of poisons may be considerably modified by disease, some diseases increasing and others lessening the action of poisons. In the latter case, large doses are usually required to produce the desired effect.

Poisoning may either be acute or chronic. Acute poisoning is the condition brought on by taking an overdose. Chronic poisoning is the condition brought on by taking repeated doses of a poison or as the result of the absorption of the poison over a long period.

CLASSIFICATION OF POISONS

Gaseous Poisons

These poisons are present in the gaseous state and if inhaled, destroy the capability of the blood as a carrier of oxygen and irritate or destroy the tissues of the air passages and lungs. When in contact with the skin and mucous membranes, gaseous poisons produce lacrimation, vesication, inflammation, and congestion. Examples are carbon monoxide, carbon dioxide, hydrogen sulfide, sulfur dioxide, ammonia gas, chlorine gas, and chemical warfare agents

Inorganic Poisons

Inorganic poisons fall into two classes: (a) Corrosives, which are substances that rapidly destroy or decompose the body tissues at point of contact. Some examples are hydrochloric, nitric, and sulfuric acids; phenol; sodium hydroxide; and iodine. (b) Metals and their salts, which are corrosive and irritate locally, but whose chief action occurs after absorption when they damage internal organs, especially those of excretion. Some examples are arsenic, antimony, copper, iron, lead, mercury, radioactive substances, and tin.

Alkaloidal Poisons

These poisons are nitrogenous plant principles that produce their chief effect on some part of the central nervous system. Some examples are atropine, cocaine, morphine, and strychnine.

Nonalkaloidal Poisons

These poisons include various chemical compounds, some obtained from plants, having hypnotic, neurotic, and systemic effects. Some examples are barbiturates, salicylates, digoxin, and turpentine.

EFFECTS AND SYMPTOMS OF POISONS

For convenience of study, the following general classification of poisons is based according to their effects on the body and the general symptoms of poisoning.

Corrosives

Corrosives are substances that rapidly destroy or decompose tissues at the point of contact. Note: See(a) under Inorganic Poisons.

GENERAL SYMPTOMS.— Immediately, if taken orally, there is burning pain in the mouth with severe burning in the esophagus and stomach. This is followed by retching and vomiting; the stomach contents are mixed with dark-colored liquids and shreds of mucous membrane from the mouth, esophagus, and stomach. The inside of the mouth is corroded and the lips present a characteristic stain if an acid has been used. Swallowing is very difficult, respiration is impeded, the abdomen is tender and distended with gas, the temperature is high, and the facial expression shows anxiety and great suffering.

Irritants

Irritant poisons are those agents that do not directly destroy the body tissues but set up an inflammatory process at the site of application or contact. Some examples are potassium nitrate, silver nitrate, arsenic, and phosphorus.

GENERAL SYMPTOMS.— There is usually nausea, vomiting, and purging (frequently the vomitus and stools contain blood), pain, and cramps in the abdomen. In some cases, there is inflammation of the urinary tract.

Neurotics

Neurotics are poisons that act on the brain, spinal cord, and the central nervous system. Some examples are opium, ether, chloroform, belladonna, ethyl and methyl alcohol, and the barbiturates.

GENERAL SYMPTOMS.— Symptoms may be divided into two subclasses.

Depressants.— They produce symptoms characterized by a period of exhilaration, followed by drowsiness and stupor; slow breathing; cold, clammy skin; cyanosis; slow pulse; muscular relaxation; dilated or contracted pupils; and insensibility to external impressions.

Stimulants.—These produce symptoms characterized by rapid and feeble pulse; delirium; hot and dry skin; a sense of suffocation and the inability to breathe; shuddering and jerking of muscles; dilated or contracted pupils; distorted vision; and sometimes convulsions and tetany. Examples are strychnine or amphetamines.

Gaseous Poisons

These are poisons present in the gaseous state and, if inhaled, destroy the oxygen carrying property of the blood and irritate the tissues of the lungs and air passages. When in contact with the skin or mucous membranes, gaseous poisons are highly irritating.

GENERAL SYMPTOMS.— These include irritation and corrosion of the respiratory tract, with resultant bronchitis (either mild or severe) and irritation of the eyes, mouth, stomach, and kidneys.

Food Poisoning

Food poisoning can cause acute attacks of illness in more people in a short time than any other condition. The term food poisoning is conventionally divided into two types, FOOD INTOXICATION and FOOD INFECTION.

Food intoxication is due to a specific toxin produced outside the body; for example, the toxin in *Clostridium botulinum.* Other organisms cause food intoxication by producing toxins, the exact nature of which is imperfectly understood. These toxins are formed under suitable conditions, usually by Staphylococci, occasionally by Streptococci, and rarely by Coliform and Proteus groups.

Food infection is usually caused by a specific group of organisms, namely the Salmonella group, but occasionally by the dysentery group.

GENERAL SYMPTOMS.— Gastrointestinal distress, nausea, vomiting, maybe diarrhea, urticaria, and circulatory and nervous system disturbances are the general symptoms of food poisoning. They may vary from mild discomfort to violent disturbances of the normal functions of the body. In more acute forms, the necrologic symptoms may overshadow the gastrointestinal symptoms, followed by collapse. Death is usually due to respiratory paralysis, cardiac failure, or secondary pneumonia.

POISON CONTROL CENTERS

The United States Public Health Service has established a clearing house for poison information. Its chief purpose is to interchange information with many local poison control centers established throughout the country. The centers have been established at major medical centers

and operate on a 24-hour a day basis. Every medical facility should make an attempt to use the services of the poison control center contiguous to its activity.

TREATMENT OF POISONING

The basic procedure is as follows:

1. Remove the bulk of the poison out of the stomach quickly. Removal of the poison from the stomach may be accomplished by the use of emetics and by washing out the stomach through use of a stomach tube.
2. Administer an antidote for the remainder of the poison left in the stomach.
3. Eliminate from the system that portion of the poison that has been absorbed.
4. Treat the symptoms as they arise.
5. Take possession of all foods, medicines, vomitus, feces, urine, and anything that may be of value in determining the identity of the poison and whether taken accidentally or intentionally, or criminally administered.

Cases of poisoning are frequently encountered where the services of a physician or poison control center are unavailable. In these cases, it often happens that it is impossible to obtain much or any information relative to the nature or type of poison taken. Since any delay in treatment may result in serious consequences, every hospital corpsman should possess some practical knowledge of how to manage a poisoning case when the nature of the poison is unknown.

For the purpose of general treatment in unknown poisons, the case may be considered as one of two kinds. It may either be a case in which the local effects of the poison have injured the mucous lining of the mouth, esophagus, and stomach to an extent contraindicating the use of instruments or emetics for evacuating the stomach or it may be a case where the poison has had little or no effect on the mucous lining of the alimentary tract and therefore one in which it would be safe to use a stomach tube or an emetic.

Poisonings coming under the classification of corrosives generally produce conditions such as mentioned in the first instance. They have a more or less injurious and even destructive effect on the lining of the mouth and stomach. Naturally, in such cases the introduction of any sort of instrument, even a soft rubber stomach tube, may result in a perforation in the weakened wall. In such conditions, rupture of the stomach maybe caused by emesis. Poisons classified as irritants and neurotics generally have no special local or injurious action on the mouth and the stomach and therefore in such cases the stomach may be evacuated and washed with the aid of a stomach tube. In the absence of a stomach tube, emetics may be used without fear of injury.

In cases where there are no signs of injury to the lining of the mouth, the probabilities are that the poison is one of the irritants or neurotoxins; that is, the poison may be a salt of one of the poisonous metals, such as arsenic, mercury, or silver. It may be one of the crude drugs, such as opium, belladonna, or perhaps one of their many alkaloids, the most common of which are morphine, codeine, heroin, atropine, and strychnine.

EMETICS

There are many drugs that produce nausea and vomiting, but the number that may be used intentionally to cause a patient to vomit is relatively small. Vomiting may be stimulated by gagging or stroking the throat with the finger or a tongue depressor when the stomach is full of liquid. When an emetic is required, the following may be considered:

- 1 to 3 teaspoons of powdered mustard in a glass of warm water
- Warm, soapy water
- Warm, salty (2 teaspoonfuls of table salt) water
- Ipecac syrup, 15 to 30 ml

REGULATIONS AND RESPONSIBILITIES PERTAINING TO CONTROLLED SUBSTANCES, ALCOHOL, AND DANGEROUS DRUGS

Hospital corpsmen handling controlled substances and other drugs are held responsible for their proper distribution and custody. Nowhere is the demand for strict integrity more important. Misuse, abuse, loss, and theft of these substances has always, sooner or later, ended in tragedy and severe consequences. No one has ever profited by their misappropriation.

It behooves every hospital corpsman to thoroughly understand the responsibility concerning the custody and handling of controlled substances and other drugs and to be familiar with the regulations and laws pertaining to them.

RESPONSIBILITY

Although MANMED, chapter 21, specifically assigns custodial responsibility for controlled substances, alcohol, and dangerous drugs to a commissioned officer and more specific control to the Nursing Service, you, as a hospital corpsman, are held responsible for:

1. All controlled substances and other drugs entrusted to you.
2. Their proper administration: the right drug at the right time to the right patient in the right way.
3. Their proper security. All controlled substances and other drugs are to be kept under lock and key. Neither keys nor drugs are ever entrusted to a patient.

ACCOUNTABILITY

Hospital Corps personnel are held accountable for all quantities of drugs entrusted to them. Exercise great care to prevent the loss or unauthorized use of drugs. No drug will be administered without proper authority. In addition, U.S. Navy Regulations distinctly forbids the introduction, possession, use, sale, or other transfer of marijuana, narcotic substances, or other controlled substances.

DRUG DEFINITIONS

Although all drugs are to be treated with respect, certain groups require special handling and security measures. Controlled substances are those drugs listed in the Comprehensive Drug Abuse Prevention and Control Act of 1970, and alcohol. Schedules of controlled substances are established by this act. Products may migrate between schedules and new products may be added. These changes will be promulgated by the Navy Materiel Support Command in the Medical and Dental Materiel Bulletin.

Controlled drugs are controlled substances, plus any additional drug product designated for control by an appropriate military authority.

Accountable controlled substances and drugs are all items listed on schedules I, II, narcotic schedule III medications, non-narcotic schedule III medications, schedule IV and V, or other legend drugs that appropriate authority in the chain of command deem necessary for accountability procedures. The schedules of drugs will be discussed later.

Dangerous Drugs

Poisonous drugs, chemicals, and similar substances are classified as dangerous drugs. Drugs of a powerful nature that may be mistaken for other drugs because of their appearance will be kept in containers of distinctive color, size, or shape in a special section wherever drugs are stored. In addition, the following specific safeguards will be enforced:

1. All dangerous poisons are to be indicated by appropriate poison labels.
2. Caustic acids such as glacial acetic, sulfuric, nitric, concentrated hydrochloric, or oxalic acids will be stored in appropriate containers and not issued to wards or outpatients.
3. Methyl alcohol (METHANOL) (for use by medical activities) will be accounted for and issued by the supply division in the same manner as other controlled substances. Methanol will not be stored, used, or dispensed by the pharmacy, ward, or outpatient treatment facility.

MANUAL OF THE MEDICAL DEPARTMENT

For all intents and purposes, MANMED, chapter 21, directs precise measures to be taken to ensure the proper control and custody of controlled substances, controlled drugs, and accountable controlled substances and drugs. The Comprehensive Drug Abuse Prevention and Controlled Act of 1970 established five schedules dependent upon a drug's potential for abuse, medical usefulness, and degree of dependency, if abused. The following schedules are provided:

1. Schedule I substances—Maximum abuse potential with little or no accepted medical usefulness (i.e., heroin, marijuana, LSD).
2. Schedule II substances-High abuse potential and accepted medical usefulness; abuse leads to severe psychological or physical dependence (i.e., morphine, meperidine, amphetamines, pentobarbital). Prescriptions for any of these substances MAY NOT be refilled.

3. Schedule III substances—Lesser degree of abuse potential with accepted medical usefulness; abuse leads to moderate dependence (i.e., paregoric, some barbiturates, Tylenol #3, Fiorinal). Prescriptions may be refilled up to five times within 6 months.
4. Schedule IV substances—Low abuse potential with medical usefulness; limited dependence problems (i.e., diazepam, pentazocine, phenobarbital, chlordiazepoxide, flurazepam). Prescriptions of these may be refilled up to five times within a 6-month period.
5. Schedule V substances-Low abuse potential, accepted medical usefulness, and limited dependence factors (i.e., Lomotil, ETH with Codeine). Prescriptions maybe refilled up to five times within 6 months.

ANTIDOTES AND ANTIDOTE LOCKERS

All persons in the Medical Department will be aware of the danger of poisons and the use of antidotes. A separate poison antidote locker marked "ANTIDOTE LOCKER" will be located prominently in every emergency room. If necessary, you may use more than one locker. In small ships with only one independent duty hospital corpsman aboard, the locker will be located immediately outside the emergency treatment room for ready accessibility y when the corpsman is absent. Secure the locker with a seal. Whenever the seal is broken, the contents will be inventoried, the used antidotes replaced, and the locker resealed. Place an inventory list for each shelf on the inside of the door together with a copy of NAVMED P-5095, Poisons, Overdoses, and Antidotes, and the address and telephone number of the local poison control center.

All personnel involved in emergency room treatments will be thoroughly familiar with the contents of the locker and their use. The books, *Clinical Toxicology of Commercial Products,* by Gleason, Gosselin, Hedge, and Smith and *Handbook of Poisons,* by Robert H. Driesback, M.D. are recommended as reference material and should be outside the locker for easy reference. The list may be modified to meet local requirements; however, it is very important to keep each item up-to-date to avoid depletion or spoilage.

For further information, consult MANMED, chapter 21.

REFERENCES

1. NAVMED P-117, *Manual of the Medical Department,* chapter 21

2. *Drug Facts and Comparisons,* 1985 ed. Philadelphia: J.B. Lippincott

3. Goodman and Gilman's, *The Pharmacological Basis of Therapeutics,* ed 6. New York: The Macmillan Co.

4. *Physicians' Desk Reference,* ed 37. New Jersey: Medical Economics Co, Inc.